

1905 Introduction: How Things Work and all that



Peter
Watson

Jean Tinguely
Sculpture, Zurich

e.g. Mobile phone

- Many levels:
 1. User level (Software/Systems)
 2. Hardware level (Engineering)
 3. Physics level (Solid state, optics...)



Wikipedia

Note that no level makes sense without the other

Physics level encompasses

- Materials (conductors, insulators, semi-conductors, liquid crystals)
- Radiation (microwaves)
- Optics (camera)
- energy storage (battery)
- Circuits

Text

So what is this course designed to do?

- Make you a designer of mobile phones?
- Convince you to become a physicist?
- **Arm you to be a scientifically literate citizen**

Text

e.g. Global Warming: is it real?

- I don't believe in global warming and nothing you can say will make me change my mind



PW

e.g. Global Warming: is it real?

- The science is so uncertain you can't conclude anything

YES, FROM THE EVIDENCE IT LOOKS PRETTY LIKELY TO ME THAT WE'RE CAUSING GLOBAL WARMING ON A HORRIFIC SCALE. BUT WITH SCIENCE YOU DON'T NEED TO ARGUE. IT DOESN'T MATTER WHO WINS THE DEBATE-- IT'S ABOUT REALITY. BY JUST WAITING A LITTLE LONGER, WE'LL GET TO SEE WHO WAS RIGHT. IT FEELS UNETHICAL, BUT I FIND MYSELF WANTING TO KEEP QUIET ABOUT THE SCIENCE JUST TO KNOW FOR SURE. AS TERRIBLE AS IT SOUNDS, THE STATE OF THE WORLD ISN'T REALLY MY RESPONSIBILITY. I'M JUST THRILLED TO GET TO WATCH. IF THE SCIENTISTS ARE RIGHT -- AND IF WE KEEP PEOPLE FROM UNDERSTANDING JUST A LITTLE LONGER -- WE'LL ENJOY QUITE A RIDE. AND PRAGMATICALLY, ON THE OUTSIDE CHANCE THAT THEY'RE ALL WRONG, I GET SAVED THE EMBARRASSMENT OF HAVING SPOKEN UP.



XKCD comics

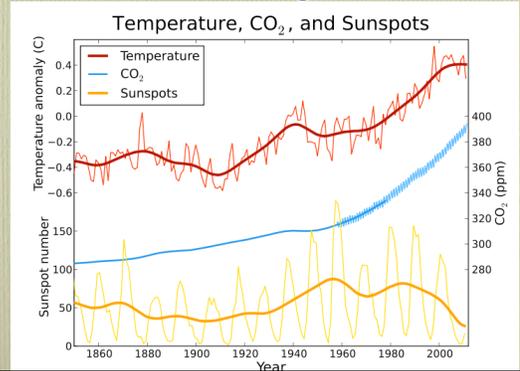
Text

e.g. Global Warming: is it real?

- No, it's a fraud perpetrated by a few scientists and it's been exposed

e.g. Global Warming: is it real?

- Yes, the earth is warming but it's got hotter and colder a lot of times in the past and this is nothing new: mankind has nothing to do with it



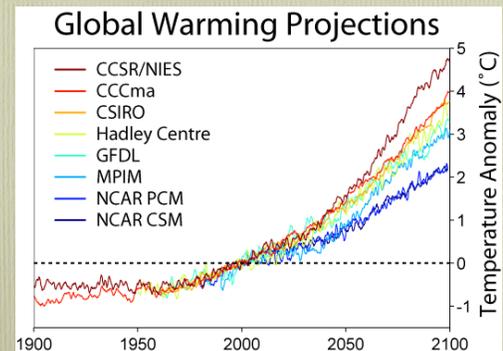
e.g. Global Warming: is it real?

- No one has any idea: we can't predict the weather in Ottawa next week, so how can we predict the world's climate in 50 years?

Text

e.g. Global Warming: is it real?

- Look, the projections are all over the place, so we can't predict anything



e.g. Global Warming: is it real?

- It's got nothing to do with physics: we know all the science necessary, and unless the politicians fix it, the average temperature will be up by 5°C by 2030.

Text

e.g. Global Warming: is it real?

- The world is **definitely** getting warmer
- It is a complex problem
- Scientists are normally honest, and will give a range of uncertainty
- As our data gets more complete and our calculations get better, we'll get more accurate predictions

Text

PHYS 1905 FAQs

- Who are you?
- Peter Watson
- How do I find you?
 - Best: mail to watson@physics.carleton.ca and put something sensible in the subject line
 - HP 3318 520-2600 x4318
 - Office Hours: 10-noon Wednesdays specifically. Most other times, but send me an Email to make sure I am there.
 - www.physics.carleton.ca/~watson
 - Note: all course information is posted here

PHYS 1905 FAQs

- Who will help?
- Two very important people from CUOL
- Nestor Querido <nestor_querido@carleton.ca>
- Supervisor, CUOL Support Services x 1898
- Renea Free <renea_free@carleton.ca>
- CUOL Examinations Coordinator. x2194

PHYS 1905 FAQs

- How does CUOL work?
- Information and Assistance

CUOL website: www.carleton.ca/cuol

Video On Demand login page: <https://vod.cuol.ca/vod>

CUOL Student Centre: D299 Loeb, 613-520-4055

Email: cuol@carleton.ca (general information)

Email: vod@carleton.ca (Video On Demand support and questions)

Accessing Lectures

- Lectures are recorded during the on-campus section of the class. Students in the CUOL section (T or V) can access the lectures in the ways listed below.
- Television Broadcast (Rogers Digital Cable Channel 243, at time listed in class schedule)
- CUOL [Webcast](#) – at time of broadcast
- Video-On-Demand - online streaming of all available lectures anytime (\$50 fee applies per term, \$40 in the summer). To add the service, go to Carleton Central and add section VOD if you are in section V, or TOD if you are in section T, to your existing enrolment. If you are in the on-campus class, there will be a matching "OD" section that you can add to get access to the lectures. Log in [here](#) to view your lectures using your CULearn (formerly WebCT) login and password.
- CUOL Student Centre, D299 Loeb: free Viewing Kiosks
- Pay per Lecture – online rental of individual lectures, fee applies

For more information see: <http://www2.carleton.ca/cuol/access-your-courses/>

Exams

- Local students write their exams at the scheduled time on campus. Distance students (living further than 100 km from campus) write midterms and exams at a distance from Carleton only if they apply for this service. Otherwise distance students are expected to write all exams at Carleton. For general information on exams, schedules, service charges and deadlines, and the Distance Exam application, see: <http://www2.carleton.ca/cuol/examination-services/>

Text

Return of Graded Material

- If the Instructor has graded material to be returned to students, it may be held for pick-up in D299 Loeb. Picture ID is required to collect the assignments/midterms. The material is mailed out to students who live more than 50 km from campus, so make sure your address in Carleton Central is up-to-date!

Text

Statutory Warning

- This is an experimental course
- You are guinea pigs
- Content is flexible
- CUlearn is (mildly) flaky

PHYS 1905 FAQs

- Who will help?
- Chad Hunter (TA)
- How do I find you?
 - Best: mail to chunter@ottawaheart.ca and put something sensible in the subject line

PHYS 1905 FAQs

- What's the textbook?
- “**Conceptual Physics**”, 11th Edition Paul Hewitt, (Pearson)

PHYS 1905 FAQs

How is the course evaluated?

1. (35%) on-line tests (using CUlearn) approximately every week: a schedule will be published later.
2. (25%) An essay on a topic related to one of the topics to be submitted before the last week of classes.
3. (10%) midterm exam, multiple choice and covering the material in the first six weeks of term
4. (30%) Final exam will be multiple choice and will cover all of the topics above

Text

PHYS 1905 FAQs

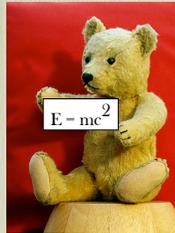
- Can I get the slides you are using?
- You can access the notes directly via <http://www.physics.carleton.ca/~watson/>. Note that the notes are supplied as PDF files, which you can download
- Why don't you supply the notes as a hard-copy?
- You have a text-book
- It's too expensive.
- There are always a few errors that sneak through.

Do I need Maths?

- No. You will need arithmetic, and how to evaluate a formula
- Most important is “order of magnitude” calculations: e.g.
- How much power do you use?
- How much power does Canada use?
- How much power does a solar panel produce?
- How many solar panels would Canada need to produce all of its power?

Statutory warning!

- **I** will occasionally use maths: can get results very fast.
- **You** won't need it.
- If you are intimidated, cuddle the Teddy Bear

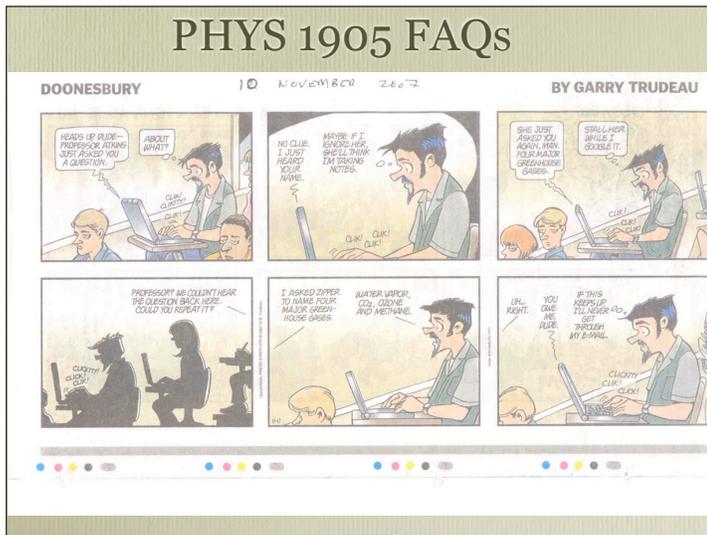


Waugenberg, Wikipedia

PHYS 1905 FAQs

- Why don't you post the solutions to the problems you pose in class?
- Because you can only learn to do calculations by doing calculations! Just reading through solutions is useless.
- Why don't you follow the textbook exactly?
- Because you can read!
- Because there is (far) too much in the textbook!

PHYS 1905 FAQs



PHYS 1905 FAQs

- I've got a really important call to answer this morning. Is it OK if I take it on my cell phone?
- Sure. You can always keep your cell-phone on in class. If it rings you get to buy treats for the whole class.
- My dog died/house burned down/roommate went psycho/World War 3 broke out/I was really hungover so my assignment was late. What can I do?
- Find a better excuse

PHYS 1905 FAQs

- I could only get a flight to Fort Lauderdale/Whistler/Acapulco on the day of the exam: can I get my exam postponed?
- No, but by paying first-class fare for the professor, he will be able to accompany you on the trip and give you the exam at the right time

PHYS 1905 FAQs

- I really did get sick, and had to miss an exam/on-line assignment
 - For an online assignment: we drop the worst in the term: i.e. Don't bother asking me!
 - Get a medical certificate for an exam: this must be within one day of the date of the exam.
 - For the final exam, apply for a deferred.

PHYS 1905: How Things Work

- **Objective**

Intended for students with little or no background in Science. Physics has an impact on all aspects of everyday life. This conceptual course looks at the physics behind everyday objects to learn about the basis for our modern technological world, and how new ideas will affect our future.

- We will cover a number of topics, but via questions.
- The Physics will be on a “need to know” basis

Transport

- What governs how efficient our cars can be?
- Are hybrid or plug-in cars the answer?
- Does public transport (buses and trains) use energy more efficiently?
- Can we reduce the pollution due to transport?
- Why is it so much easier (cheaper) to travel horizontally than vertically?

This means we need to understand motion, force and energy:

Chaps 2,3,4,7, weeks 1-2

Weather and Climate

- If we cannot predict the weather over more than a week, how can we hope to predict climate change of a century?
- If there are equations that describe the weather, why can't we predict where hurricanes will go?
- Why is carbon dioxide so important?
- How certain is the science?

We need to understand heat, temperature and meteorology and energy:

Chaps 15,16, 17, 18 Weeks 3-4

Electricity and Power

- How does electricity work in the natural world?
- Where does our electrical power come from now?
- Will wind and solar power generate enough to replace fossil fuels?
- Is our system for distributing power adequately protected against natural disasters?
- How much should power cost?

We have to revisit energy and then understand what electricity is.

Chap 7, 22,23. Weeks 5-6

Electromagnetic Radiation

- What is EM radiation?
- Why does light seem so different from radio-waves and X-rays?
- How do we choose what radiation to use for communication?
- How do lenses work?
- How do X-rays penetrate the body?
- Why do we see visible light as colours, but cannot see UV?
- Why are sunsets red?

We need to see how EM waves work, how light is made and why quantum theory starts to matter.

Chap 26,27,30, 31. Weeks 7-8

Nuclear Physics

- What is nuclear radiation?
- Does it occur naturally?
- Why do we need protection?
- How do MRI machines show us the workings of our body?
- What happened at Chernobyl and Fukushima?

This starts with atoms and then takes us to the structure of the nucleus.

Chaps 11, 32,33 34. Weeks 9-10

Physics in the News

- Why should you care about giant-magneto resistance?
- Why does a thin layer of carbon give us a totally new kind of material, and what could we do with it?
- What does it mean if the Higgs particle is found (or not)?
- Could we actually think of making an “invisibility cloak”?
- What are dark matter and dark energy?

Weeks 11-12

Assignment I

- Think of a question you would like the course to discuss and submit it via CUlearn
- 5/10 for the question
- 4/10 for why it's a good question
- 1/10 for your estimate of whether it's easy or hard

Assignment I

- Estimate of whether it's easy or hard on a 5 point scale:

1. I can guess the answer myself
2. My prof. should know the answer and be able to tell me immediately
3. I think it's hard, but I'd guess we could cover it in this course
4. I'd guess it's a problem for a graduate course in physics
5. I don't think it has an answer

e.g.



- Why is the sky blue?
- I've noticed the sky is bluest at midday on a cold day, but when it's smoggy it's whiter. Would it be blue on other planets? Is it blue on the moon?
- 3. I'd guess it's not simple, but I'm sure it can be explained.

OK, How about some physics?

- First some general stuff