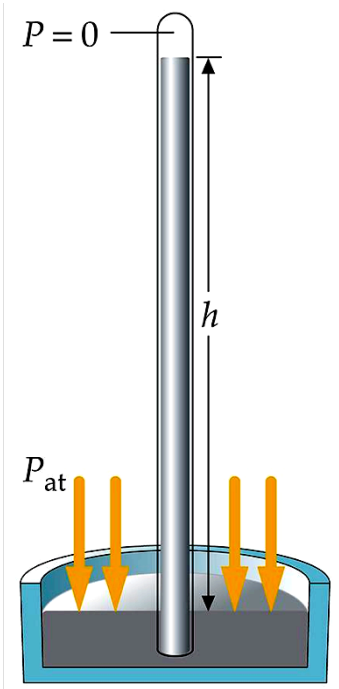
Physics 115
General Physics:
FLUIDS, HEAT and ELECTROMAGNETISM



Session 1
Course Introduction

- **R. J. Wilkes**
- Email: phy115a@u.washington.edu

- Home page: http://courses.washington.edu/phy115a/

First: an introduction to the lab course

- PHYS 118 is a **separate course**
  - Please do not ask me about schedule, your lab grades, etc!
- Prof. Robert Van Dyck will tell you more...

Class Resources

- Professor: R. Jeffrey Wilkes
  - Email: *phy115a@uw.edu*
  - Office hours: 2:30-3pm M, T, Th in room B-303, or by appt.
- Basic resource: class home page:

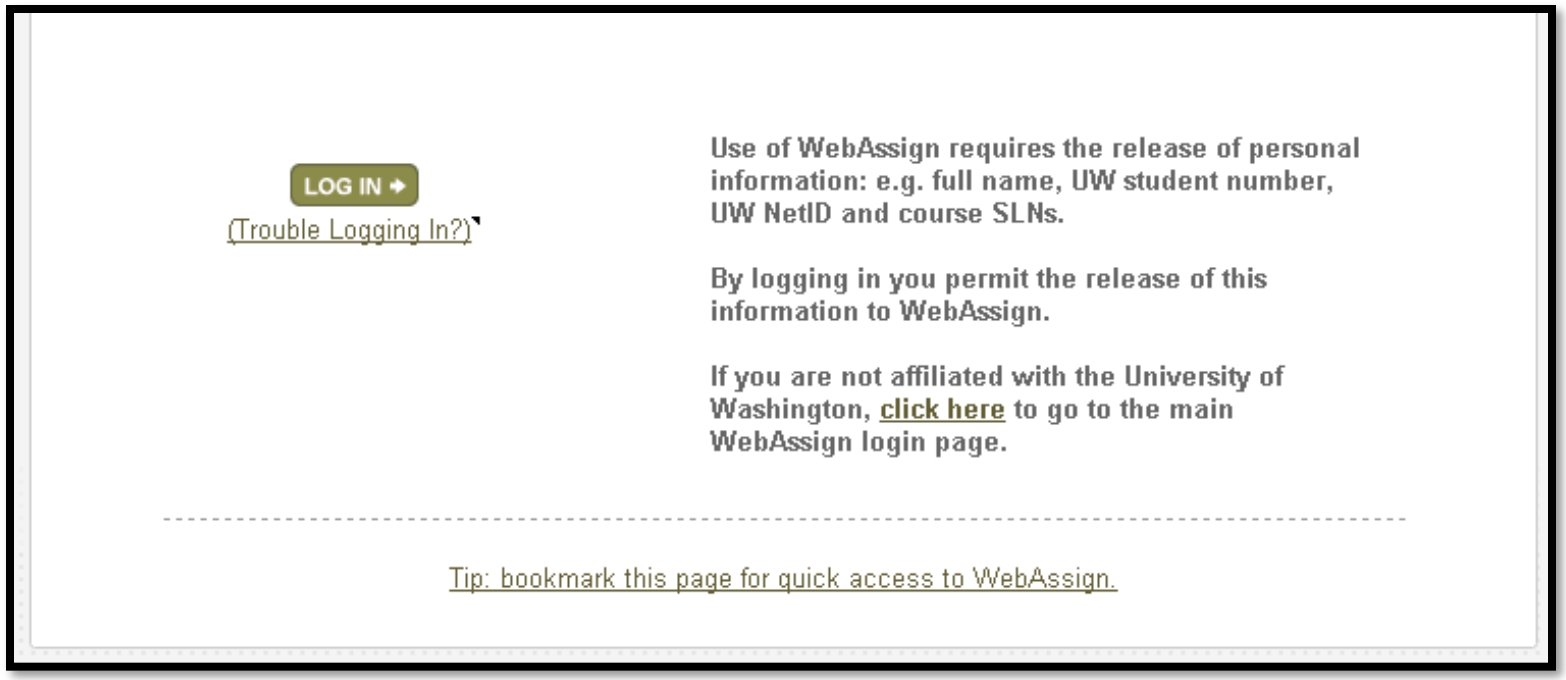
  courses.washington.edu/phy115a/
  - Syllabus, calendar, class info, and links to other resources
  - Revisit frequently to check for announcements and updated course info!
    - Don't forget to reload to make sure you see latest version
- Webassign page
  - for homework and grades:

  webassign.net/washington/login.html
  - Open now

WebAssign: Where Do I Log In ?

- Go to the Login page at

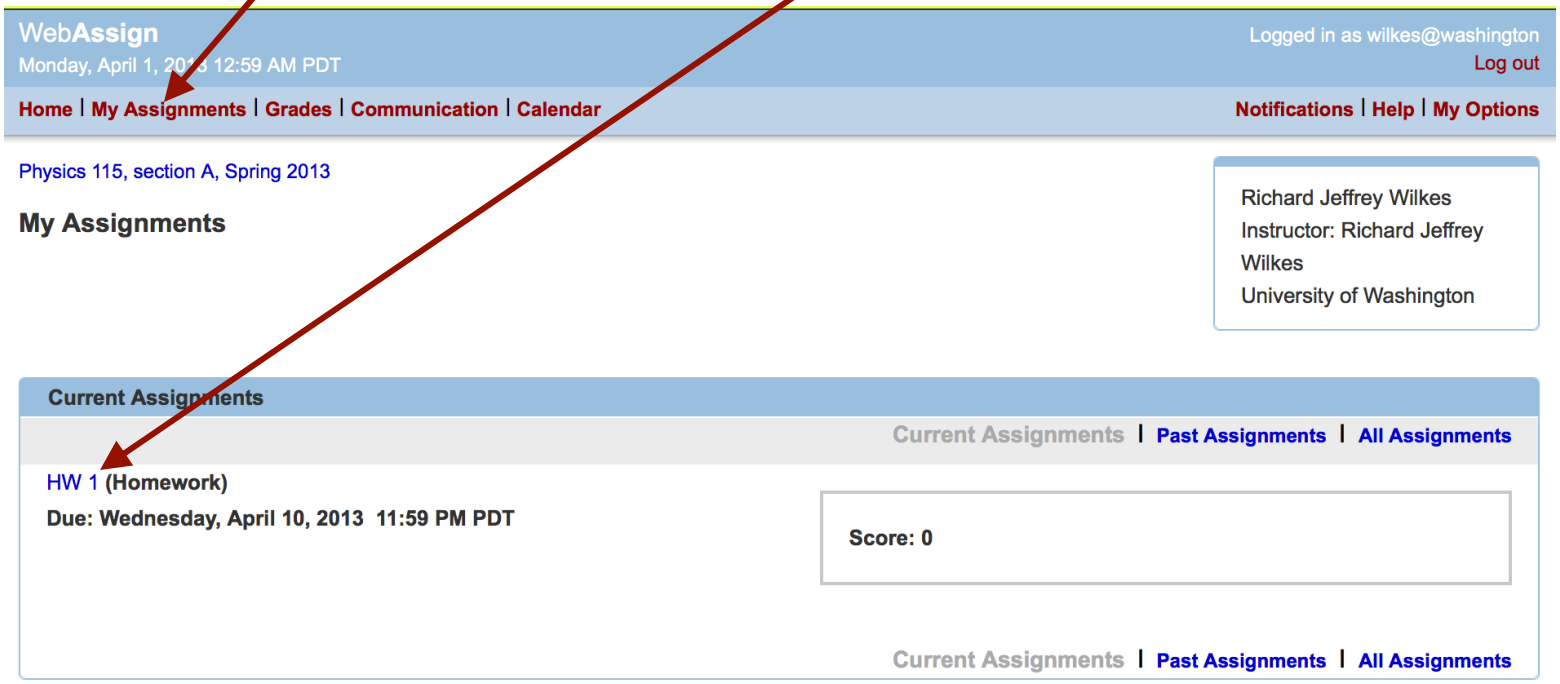
  http://webassign.net/washington/login.html



- LOG IN using your UW Net ID.
- Homework sets are due 11:59 pm Wednesdays
  - Homework set 1 is available now – due next week

All HW Assignments and Grades on WebAssign

Homework sets are submitted online.
No work is accepted past the due date.
Click on My Assignments, then HW name to begin .



Grades for WebAssign homework are stored under the lecture section.
NOTE: Labs are separate classes – your lab grades are stored separately, under lab sections.

Example: First page of HW1
(now available – due weds 4/9 11:59 pm)

Current Score: 0/100 **Due:** Wed Apr 9 2014 11:59 PM PDT

Question	1	2	3	4	5	6	7	8	9	10	Total
Points	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/100

10 problems assigned, total 100 pts

1. 0/10 points — Walker4 15.P.005. [1094699]

A cube of metal has a mass of 0.075 kg and measures 3.03 cm on a side. Calculate the density and identify the metal.

2700 kg/m^3

- lead
- silver
- iron
- gold
- aluminum

2. 0/10 points — Walker4 15.P.008. [1094653]

A 61-kg person sits on a 3.7-kg chair. Each leg of the chair makes contact with the floor in a circle that is 1.6 cm in diameter. Find the pressure exerted on the floor by each leg of the chair, assuming the weight is evenly distributed.

7.89e+05 Pa

Other Class Resources

- Book (required) Physics, James Walker, vol.2
- Go-post page (class message board):
  - link on home page =

catalyst.uw.edu/gopost/board/wilkes/36339/

Post questions (perhaps a classmate can answer), comments, suggestions, interact with fellow students

  - TA will check at least weekly
- Umail = Confidential message sender

see link on home page =

catalyst.uw.edu/umail/form/wilkes/4382

Still more class resources

- Your Fellow Students
  - You're encouraged to study and discuss class together!
  - Homework and exams for sections A and B are coordinated
- Physics Study Center (A-wing Mezzanine, just under our lecture room)
  - Meeting place / work space for students
  - Get guidance and help from TAs outside 116 office hours
  - Look over other textbooks on the same subjects
- Physics Library (6th floor of C-wing)
  - Best view from a comfy chair on campus!
  - This nice space will disappear after spring quarter!
- Your TA: Songci Li
  - Office hours/location TBA
  - Email questions via class email, phy115a@uw.edu

Questions are an important part of the course

- Shy people can email, or use the **? Box**, or u-mail link

  (Non-shy people will ask questions in class without prompting!)

  – Something you didn't understand in lecture

  – Something you've always wondered about, or recently noticed

  – Something that class discussion prompted you to think about

- Goal: increase your awareness

  – Physics is all around us: easy to ignore, but also easy to see!

  – Think more deeply about everyday phenomena relevant to class

"Clickers" are *required*

iCue / H-ITT Clickers (TX-3100)

- Required to enter answers in quizzes
  - Be sure to get radio (RF), *not* infrared (IR)
  - Registration: opens tomorrow:

  https://catalyst.uw.edu/webq/survey/wilkes/231214
- We'll start using them this Thursday, and use them for pop quizzes thereafter
  - Bring your clicker to class *every day* from April 3 onward
  - **YOU are responsible** for learning to program and use your clicker – if you have trouble, ask a nearby fellow-student for help.
- Why pop quizzes?
  - Motivation to attend class (physically *and* mentally)!
  - Quizzes are designed to be easy ***IF*** you are paying attention
    - Questions will be about something we just discussed!

Course grade will be based on:

- Exams
  - ALL exams will be multiple choice, YOU must bring your own mark-sense sheet (available at physics café) and pencil
  - Midterm Exams: 40%
    - 3 midterm exams: April 18, May 9, May 30
    - In-class, formula sheet provided, closed book/notes
    - Only your 2 best exam scores (out of 3) will be used, so you can miss one exam without loss, so no makeup exams
  - Final exam 30%
    - Monday June 9, 2:30-4:20 pm, this room
- Homework assignments (Webassign online): 15%
  - Best 6 out of 8 scores for complete homework sets
- Clicker quiz scores: 15%
  - Only your best 10 (out of 20 or more) grades will be used, so no makeup quizzes

Lecture Schedule (up to exam 1)

Date	Day	Lect.	Topic	readings in Walker
31-Mar	Mon	1	Introduction, Preview	
1-Apr	Tues	2	Density & Pressure	15.1-15.3
3-Apr	Thurs	3	Static Fluids, Buoyancy	15.4-15.5
4-Apr	Fri	4	Fluid Flow, Bernoulli	15.6-15.8
7-Apr	Mon	5	Viscosity, Flow, Capillaries	15.9
8-Apr	Tues	6	Temperature, expansion	16.1-16.3
10-Apr	Thurs	7	Heat, Conduction	16.4-16.6
11-Apr	Fri	8	Ideal gas	17.1-17.2
14-Apr	Mon	9	Heat, Evaporation	17.4-17.5
15-Apr	Tues	10	Phase change	17.6
17-Apr	Thurs	11	First Law Thermodynamics	18.1-18.3
18-Apr	**Fri**		**EXAM 1 Ch 15,16,17**	

Today

Topics for this week

- Fluids overview
- Density
- Pressure
- Static equilibrium in fluids
- Pressure vs depth
- Archimedes' Principle and buoyancy
- Continuity and fluid flow
- Bernoulli's equation

Read each day's assigned text sections before class

Density

$$\text{Average density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\boxed{\rho = \frac{M}{V}}$$

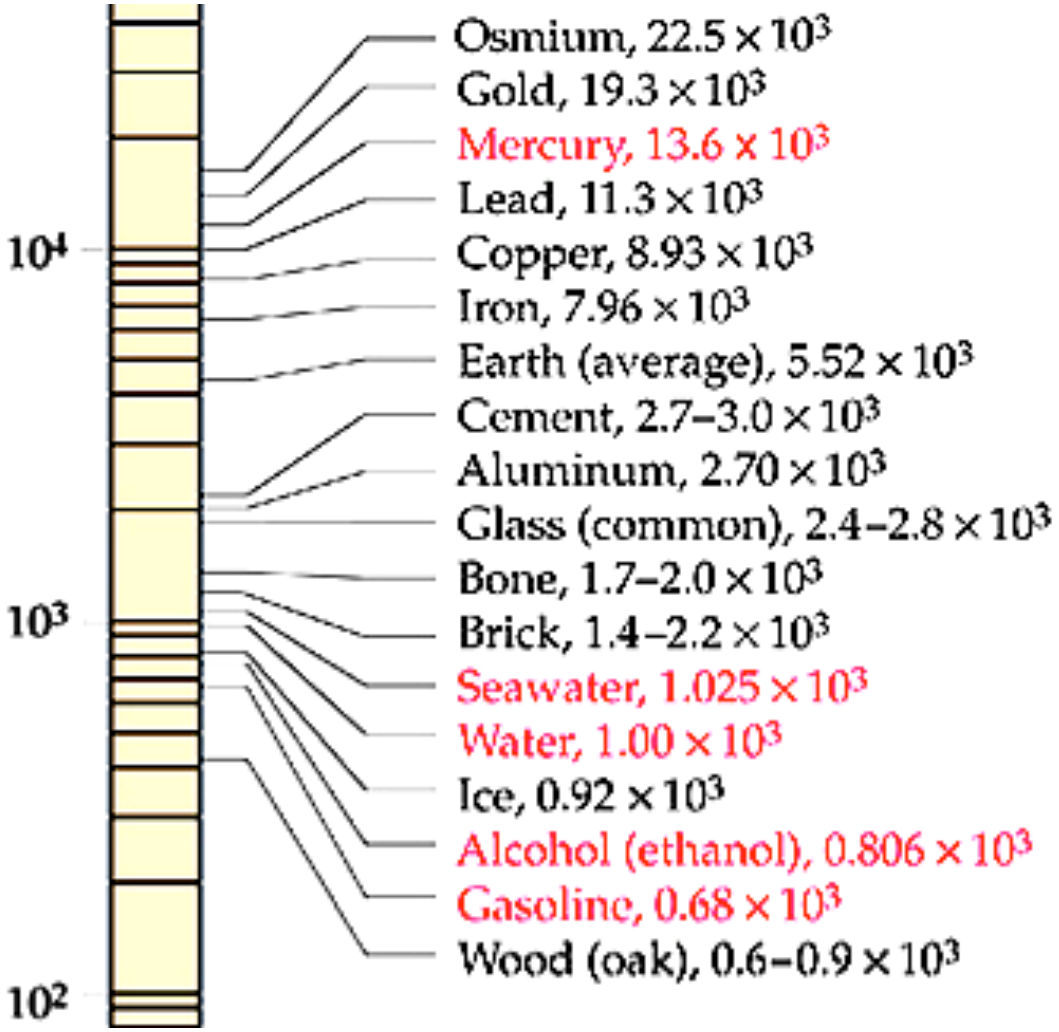
$$\rho_{WATER} = 1.0\ \text{g/cm}^3 = 1000\ \text{kg/m}^3$$

(at 4 deg C)

$$1\ \text{liter} = 1\ \text{L} = 10^3\ \text{cm}^3 = 10^{-3}\ \text{m}^3$$

$$\rho_{WATER} = 1.0\ \text{kg/L} = 1.0\ \text{g/mL}$$

Density in kg per m^3



Gases: O(0.1 ~ 1 kg/m^3)

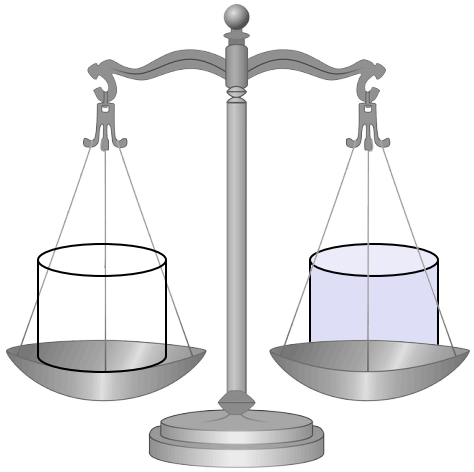
Density example

- An empty box measures 1m on each side
- What is the mass of air in the box?

$$m = \rho V = (1.205\ \text{kg/m}^3)(1.0\text{m}^3) = 1.205\ \text{kg}$$

Not so "empty"!

Weight of air demo:



Densities of some gases:

Air at 20 degC = 1.205kg/m3

H2 = .0899kg/m3

N2 = 1.165kg/m3

CO2 = 1.8421kg/m3

O2 = 1.331kg/m3

http://www.engineeringtoolbox.com/

Density example

- A flask is filled to the top with 200 ml of water at 4.0°C.
- When the flask is heated to 80°C, 6.0 g of water spill out.
- What is the density of water at 80°C?

$$m = \rho V = (1.00\ \text{kg/L})(0.200\ \text{L}) = 0.200\ \text{kg}$$

$$m' = m - 6.00\ \text{g} = (0.200\ \text{kg}) - (0.006\ \text{kg}) = 0.194\ \text{kg}$$

$$\rho' = \frac{m'}{V} = \frac{(0.194\ \text{kg})}{(0.200\ \text{L})} = \boxed{0.970\ \text{kg/L}}$$

Pressure

$$P = \frac{F}{A}$$

Pressure is force per unit area.

SI unit for pressure: pascal

$$1\ \text{Pa} = 1\ \text{N/m}^2$$

1 atm = average sea-level atmospheric P

$$= 101.325\ \text{kPa} = 14.70\ \text{lb/in}^2$$

$$= 1013.25\ \text{millibars} = 760\ \text{mm Hg}$$

$$= 1013.25\ \text{g/cm}^2$$

"Gauge" pressure

- Pressure gauges usually read P *relative to* atmospheric pressure:

  $P_g = P - P_{atm}$

- Example: Tire gauge reads 35 lb/in^2

  What is the "absolute" pressure of air in the tire?

$$101.325\ \text{kPa} = 14.70\ \text{lb/in}^2\,(psi)$$

Use this fact to convert units:

$$P_g = P - P_{ATM} = 35\,psig = \left(\frac{35}{14.7}\right) 101.325\ \text{kPa} = 241.25\ \text{kPa}$$

$$P = P_g + P_{ATM} = 101.325\ \text{kPa} + 241.25\ \text{kPa} = 342.575\ \text{kPa}$$

$$P = \left(\frac{342.575\ \text{kPa}}{101.325\ \text{kPa}}\right) 14.70\,psi = 49.7\,psia$$

Gauge pressure = "psig"
Absolute pressure = "psia"