"Nature and Nature's laws lay hid in night; God said Let Newton be! and all was light."

Alexander Pope (1688–1744), British poet

Painting of Isaac Newton carrying out his prismatic experiment (www.slate.com)

PHY100 – And Once Again…

- Homepage
  - → http://www.atmosp.physics.utoronto.ca /people/strong/phy100/phy100.html
- Portal/Blackboard
  - → I have activated the course on the Portal, but will be using the external homepage to provide course content
- Textbook
  - → *Physics: Concepts and Connections*, Fifth Edition, Art Hobson, Pearson Education (2010) – in the Bookstore
- Tutorials
  - → Begin this week: January 15, 16, 17
- Office hours
  - → 3-4 PM, Tuesdays and Thursdays, room MP710A

Tutorials

- Six groups / four time slots:

SECTION	DAY & TIME	DATES	ROOM	TUTOR
T0101	Tues, 12-1	Jan 15 – April 2	RW 142	Ben Mossbarger
T0102	Tues, 12-1	Jan 15 – April 2	LM 155	Alma Bardon
T0201	Weds, 12-1	Jan 16 – April 3	SS 2128	Rikki Landau
T0301	Weds, 1-2	Jan 16 – April 3	RW 142	Jaspreet Sahota
T0401	Thurs, 12-1	Jan 17 – April 4	RW 142	Yunsheng (Bob) Tian
T0402	Thurs, 12-1	Jan 17 – April 4	UC 177	Graham Edge

- Tutorial groups are capped at 33 students
- Last day to register on ROSI is January 20 but tutorials (and quizzes) have started
- You should be enrolled and attending this week!

NOTE-TAKING SERVICES: ONLINE!

Volunteering will be more convenient than ever before – a new online repository of notes that can be accessed 24 hrs a day, 7 days a week!

Accessibility Services requires dependable volunteer note-takers in this course to assist students with disabilities. Benefits of volunteering:

- The quality and consistency of your notes will improve
- Gain valuable (and usefull) experience
- Receive a certificate of recognition

Want to volunteer as a note-taker?
Volunteer with the service through the Accessibility Services website (http://www.accessibility.utoronto.ca/)
or review which courses have requests for note-takers at https://www.studentlife.utoronto.ca/accessibility/pcourselist.aspx
(You can also add your courses if they are not on the list, and you will be notified if your services are required.)
Currently a volunteer?
Log in to the new system at https://www.studentlife.utoronto.ca/accessibility/vollogin.aspx

Contact as.notetaking@utoronto.ca if you have any questions, concerns, or require assistance.

Current Assignments ...

For today:

- Read Sections 4.4, 4.5, 5.1

For Lecture 5:

- Read Sections 5.2, 5.5, 5.6

Suggested Conceptual Exercises:

- Ch 4: 3, 5, 9, 11, 23, 25, 27, 33, 35, 37,39, 43

Attend your first tutorial this week

Homework #1 ...

Homework #1

- Homework Assignment #1 is now available
  - → Posted under Homework on the homepage
  - → All Conceptual Exercises from the textbook
- Due in two weeks, by **11:00 AM, Thursday, January 31, 2013** (late penalty = 5%/day)
- It should be submitted in the *Drop Box* labelled for your tutorial.
  - → Basement of the Burton tower of McLennan; at the bottom of the stairs going down from the bust of Newton on the first floor
- **Avoid plagiarism and copying others' work**

Collaboration and Plagiarism

- From the UofT "**ACADEMIC INTEGRITY HANDBOOK"**

"Collaboration occurs when students work together inappropriately on individual assignments with the result that the work they submit is unacceptably similar. Students often do not consider this to be cheating because they are used to working together in high school, but it can result in an allegation of plagiarism and/or of providing/receiving unauthorized aid at UofT."

- UofT encourages students to exchange ideas with each other. This is an essential part of the learning process and is not considered cheating or plagiarism.
- However, while you may discuss an assignment in a general fashion with your class mates, AFTER such discussions you are expected to go away and write up your own work separately.
- **Ensure that any work which you submit is entirely your own.**
- Do not provide a copy of your finished work (in text form or electronically), or even a draft of your work, to another student in case s/he is tempted to use it inappropriately in completing his/her own work. If s/he does, you too may face an allegation of academic misconduct under the *Code of Behaviour on Academic Matters.*

Review of Lecture 3

Textbook, Sections 4.1, 4.2, 4.3

- Why do things move?
  - → Dynamics - relation between force and motion
- Force and acceleration
- Newton's Law of Motion (his Second Law)

$$a = \text{net force} / m$$

Plan for Lecture 4

Textbook, Sections 4.4, 4.5

- Weight - the force of gravity
- The Law of Force Pairs (Newton's Third Law)

Textbook, Section 5.1

- The idea of gravity - falling objects
- Projectile motion

Weight

The weight of an object means the (net) gravitational force acting on that object.

What is the proper metric unit for weight?

Near Earth's surface, there is an acceleration due to gravity.

- → Same for all objects, 9.8 m/s^2
- → Acceleration is g = weight/mass
- → 1 kg of gold on Earth has weight = g × mass = 9.8 newtons
- → 10 kg has weight = 98 newtons

Conceptual Exercise 23

Would you rather have a hunk of gold:

1. whose weight is 1 N on the moon
2. whose weight is 1 N on Earth
3. or either one (no difference between them)

I'd pick #1! The hunk of gold whose weight is 1 N on the Moon must have more mass than the one whose weight is 1 N on Earth (hence more gold atoms) to compensate for the lower gravitational acceleration on the moon.

Conceptual Exercise 24

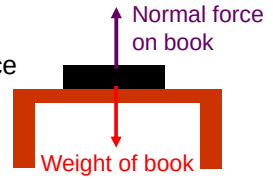
Would you rather have a hunk of gold:

1. whose mass is 1 kg on the moon
2. whose mass is 1 kg on Earth
3. or either one (no difference between them)

Either one. They both have the same mass and therefore have the same amount of gold.

Normal Forces

- Consider a book sitting on a table. It isn't moving, so the net force on it must be zero.
- Gravity is pulling it down; what holds it up?
- There is a force exerted by the surface that it is resting on
  → this is the normal force



Force Pairs

Forces always come in pairs.

- If you push on a table, the table pushes back on you. If you push harder, the table pushes back harder; if you get fed up and kick the table, the table "kicks" back.
- Experiments show that when one object exerts a force on another, the second object exerts an equal and opposite force back on the first.

The Law of Force Pairs (Newton's Third Law)

For every action, there is an equal and opposite reaction.

OR The forces of two bodies on each other are always equal in magnitude and opposite in direction.

See Textbook, Figure 4.13

Earth and a Falling Apple

So does this mean that the force exerted by the apple on Earth is equal and opposite to the force exerted on Earth by the apple?

Indeed it does. Remember that the acceleration is inversely proportional to the mass – would you expect to notice the acceleration of Earth as an apple falls?

See Textbook, Figure 4.14

Chapter 5 - Newton's Universe

"One has to be Newton to see that the moon is falling, when everyone else sees that it doesn't fall."

Paul Valery (1871-1945)

See Textbook, Figure 5.1

The Apple and the Moon

Newton realized that there is a connection between the motion of the moon and the motion of a falling apple.

See Textbook, Figure 5.1

The Acceleration of the Moon

direction of the moon's acceleration
= direction of its change in velocity

See Textbook, Figure 5.2

The acceleration points towards the center of Earth - just like the apple!

The Force Acting on the Moon

See Textbook, Figure 5.2

The gravitational force also points towards the center of Earth .

Falling Around Earth

- Imagine throwing an apple horizontally.
  - → The faster you throw it, the farther it goes.
- Throw it fast enough and it will go into orbit
  - → It will be falling all the time.

See Textbook, Figure 5.4

Let's Drop Two Balls

Flash animation
http://www.upscale.utoronto.ca/GeneralInterest/Harrison/Flash/ClassMechanics/TwoBallsGravity/TwoBallsGravity.html

What happened to Tarzan?

More famous as "the monkey and the hunter" demonstration

- shows independence of horizontal and vertical motion
- both objects fall the same distance in the same time

http://www.animations.physics.unsw.edu.au/jw/monkey_hunter.html