

# Physics 100 - September 6, 2007

## Observations

Size

$\frac{1}{10}$  millimetres

10,000 kilometres

Time

milli: second ( $\frac{1}{1000}$  second)

75 years

MASS

$\frac{1}{10}$  GRAM

1000 kg

The  
Human  
Experiences



Very  
Limited

Please become comfortable with Scientific Notation  
if you are not already ---

$$\frac{1}{10} \text{ millimeter} = \frac{1}{(10)(1000)} \text{ M} = \frac{1}{10000} \text{ M}$$

$$0.0001 = 10^{-4} \text{ M}$$

$$10000 \text{ Kilometers} = (10000)(1000) \text{ M}$$

$$= 10000000 \text{ M} = 10^7 \text{ M}$$

# Physical Scales in our universe

## Length:

Distance	Length (m)
Radius of visible universe	$1 \times 10^{26}$
To Andromeda Galaxy	$2 \times 10^{22}$
To nearest star	$4 \times 10^{16}$
Earth to Sun	$1.5 \times 10^{11}$
Radius of Earth	$6.4 \times 10^6$
Sears Tower	$4.5 \times 10^2$
Football field	$1.0 \times 10^2$
Tall person	$2 \times 10^0$
Thickness of paper	$1 \times 10^{-4}$
Wavelength of blue light	$4 \times 10^{-7}$
Diameter of hydrogen atom	$1 \times 10^{-10}$
Diameter of proton	$1 \times 10^{-15}$

## Time:

Interval	Time (s)
Age of universe	$5 \times 10^{17}$
Age of Grand Canyon	$3 \times 10^{14}$
32 years	$1 \times 10^9$
One year	$3.2 \times 10^7$
One hour	$3.6 \times 10^3$
Light travel from Earth to Moon	$1.3 \times 10^0$
One cycle of guitar A string	$2 \times 10^{-3}$
One cycle of FM radio wave	$6 \times 10^{-8}$
Lifetime of neutral pi meson	$1 \times 10^{-16}$
Lifetime of top quark	$4 \times 10^{-25}$

## Mass:

Object	Mass (kg)
Milky Way Galaxy	$4 \times 10^{41}$
Sun	$2 \times 10^{30}$
Earth	$6 \times 10^{24}$
Boeing 747	$4 \times 10^5$
Car	$1 \times 10^3$
Student	$7 \times 10^1$
Dust particle	$1 \times 10^{-9}$
Top quark	$3 \times 10^{-25}$
Proton	$2 \times 10^{-27}$
Electron	$9 \times 10^{-31}$
Neutrino	$1 \times 10^{-38}$

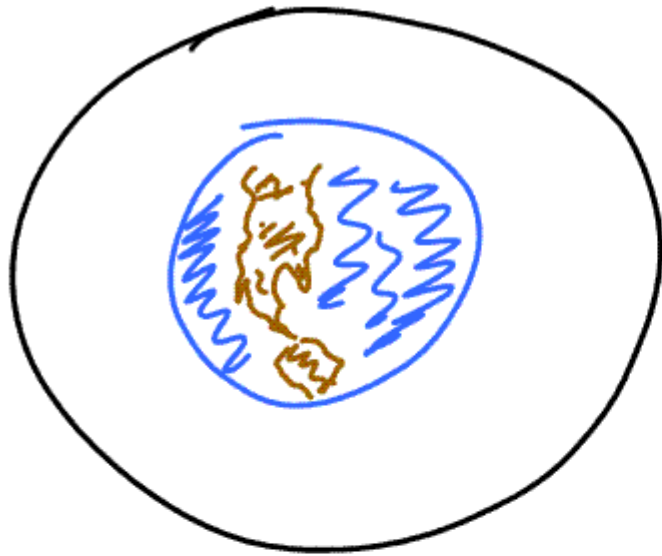
The Human  
Experience is  
a very tiny  
fraction of  
what the  
universe offers

Pick up a lead brick ...  
usually a bit of a surprise  
it is very heavy



In typical human experience things that are  
the size of a brick are not that heavy  
Consequently, you are surprised.

The human experience/expectations bias  
our opinions about what is possible and not  
possible in our view of the universe.



human experience  $\rightarrow$  earth centered universe  
Not backed up by experiment even though  
Many humans didn't like that

Why Should nature follow our naive and  
arrogant expectations??

What is science?

A way of looking at and trying to comprehend  
the world around us.

SAME for religion ...

SAME for some art ---

What sets Science Apart?

Science bows to observation

Science is testable and refutable

Science Attempts to minimize Ambiguity

Religion is irrefutable. It is a matter  
of faith and opinion

# What is truth ?

Religious truth is whatever the chosen book or prophet says.

Scientific truth does not exist.

we have scientific laws and principles that have withstood many experiments and are generally accepted.

But a single experiment can overthrow or show need for modifying the theory.

How does the mission of science lead to the nature of science ?

↳ will come back to this on Monday



# Science bows before experiment.

How does the Mission of Science, combined with the constraint above, dictate the nature of Science?

Science helps us understand and bring order to the world around us.

People must convey enough detail about a scientific observation to others that the others can attempt to reproduce the experiment/observation

detail ... units, techniques  
conditions of measurement

Makes scientific writing very dry/detail oriented  
as compared to other forms of writing

Hard to read unless you are expert

Also all observations incomplete unless provided  
with measure/estimate of how good is the  
observation

↳ observation plus  
error estimate