Precise and Accurate Measurement

Summary:

The core idea of the activity is to know following words/concepts: Least count (never zero, not necessarily the minimum measurement of that instrument), range (not only the upper limit, single measurement), uncertainty (error), propagation of error, various units of measurements.

Minimum Time Required: 2 sessions of each of minimum 40 minutes

Type of Learning Unit: Laboratory

Pre requisite: Brief knowledge of popular units, handling common instruments like measuring scale, thermometer, etc.

Introduction:

All scientific activities involve precise measurements. Development of skill in measurement involves a basic understanding of the concept of precise and accurate measurements, without which one can not undertake any scientific endeavor.

Materials required:

Geometrical instruments box (compass box), thermometers (laboratory and clinical), micrometer screw gauges, objects having shape of parallelepiped (preferably a match box), book or notebook, simple pendulum set up, stop watch, syringes, protractor, measuring cylinder, thick paper or cardboard, scissors (or cutter), any other convenient instrument.

Session-1

Task 1:

Obtain and write down the least count of the following instruments:

Sr No	Instrument	Least count	Range
1	Ruler in compass box		
2	Stainless steel ruler		
3	Protractor		
4	Wrist watch		
5	Stop watch (in mobile)		
6	Laboratory thermometer		
7	Clinical thermometer		
8	Syringe		
9	Measuring cylinder		

Task 2:

Record the ranges of all the instruments mentioned in above table.

Task 3:

Temperature measurement:

Can you guess.....

The room temperature = _____

And, your body temperature = _____

Measure the room temperature and the body temperature using laboratory thermometer (and if possible using clinical thermometer). Discuss why their observations vary appreciably.

Quantity	Clinical thermometer	Laboratory thermometer
Room temperature		
Body temperature		

Usually there is quite a large variation among the values of body temperature. Discuss the possible causes and repeat the set to have better (more consistent) measurements.

Session-2

Task 4:

Preparing scales of different least counts:

Form pairs of two students. One of them (in a pair) will prepare a measuring scale of range 0 to 10 cm with a least count of 2 mm. The other in the pair will prepare a measuring scale of range 0 to 20 cm with least count of 5 mm. Longer marks should be drawn on every 1 cm, like on any scale.

Task 5:

Measurements of the same object using scales of different least counts:

Measure length, breadth and height (thickness) of the same match box and calculate its volume with 3 different scales of least counts 1 mm, 2 mm & 5 mm respectively. It must be remembered that you are not allowed to exceed the least count, i. e., you are not allowed to record an observation to a fraction less than the least count. Hence if you are using a scale of least count 5 mm, all th readings must be in multiples of 5 mm only, and so on.

Least count of your scale	
Length (L)	
Breadth (B)	
Height (H)	
Volume = $L \times B \times H$ =	