Lecture: Measurement
9/16

Measurement Lecture

1) **Empirical Data:** experiment, evidence, research
2) **Anecdotal Data:** belief, hearsay, secondhand
3) **Quantave Research:** size, amount, number
    a. Quanty
    b. Large samples- what/where/when
4) **Qualitave Research:** observaon, characterisc, feeling
    a. Quality
    b. Small samples- how/why

Example: ate breakfast v. think breakfast important

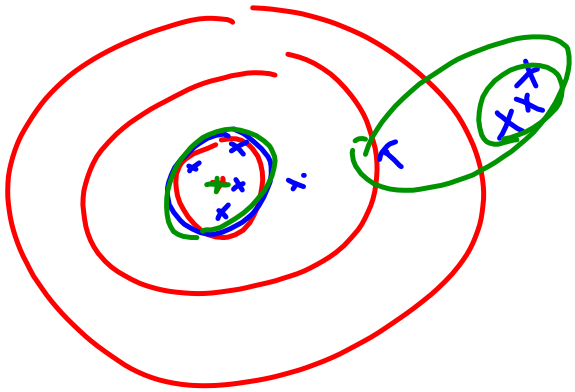
Measurement Lecture

1) **True Value:** actual measurement (i.e., 100% correct)

2) **Accurate:** how close measurement is to the true value

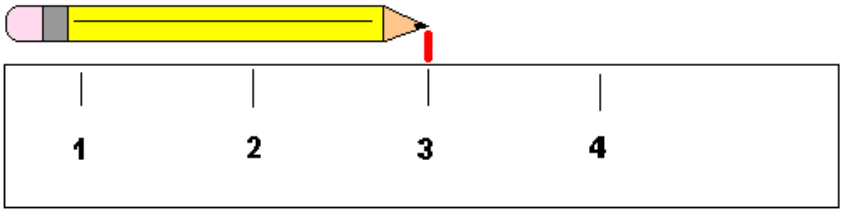
   a. Write measurement to 3rd place value (e.g., 0.002)

3) **Precision:** how close mulple measurements are to each other (i.e., grouped together)

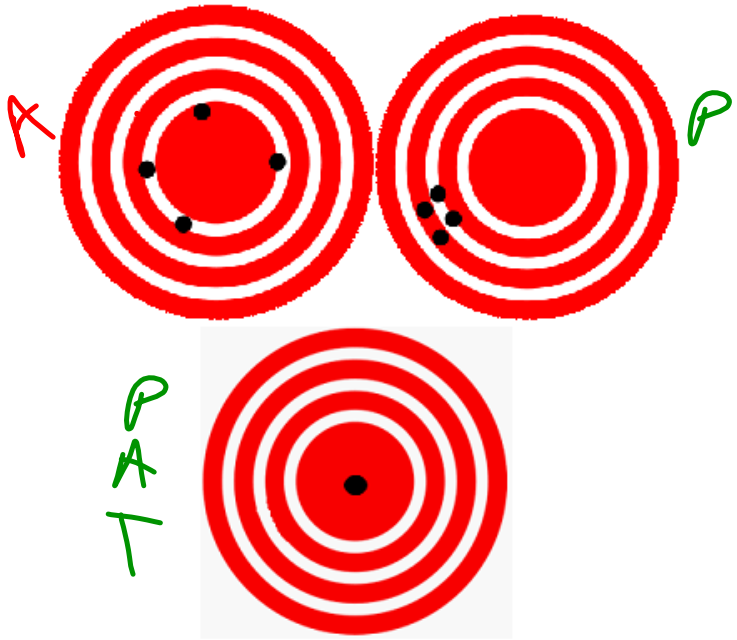


True Value: 3.154 cm

Measurements: 3.201 cm, 3.154 cm, 3.145 cm



Four darts have been thrown at each target.
Is it True Value, Accurate, and/or Precision?



True Value, Accurate, & Precision Activity

1. Shoot paper balls into a trash can
   or
2. Shoot Nerf guns at a target

Question: Use the following vocabulary to explain your results:

1. True Value
2. Accurate
3. Precision

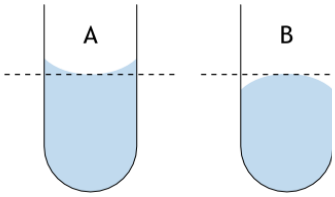
True Value, Accurate, & Precise Activity

1. Measurement (True, Accurate Precision Activ.)
   a. Measure the width of the table using a measuring analog
      i. (e.g., hand = 7.5 inches)
   b. Measure the width of the table using a ruler
   c. Measure the width of the table with a tape measure

Question: Explain your results using the following vocabulary:

1. True Value
2. Accurate
3. Precision

Measurement Lecture



1. **Meniscus:** curve to fluid being measured
   a. measurement taken from center of curve

2. **Standard Ruler:** in 1/16 inch or 1/8 inch

3. **Metric System:** decimal system for measurement

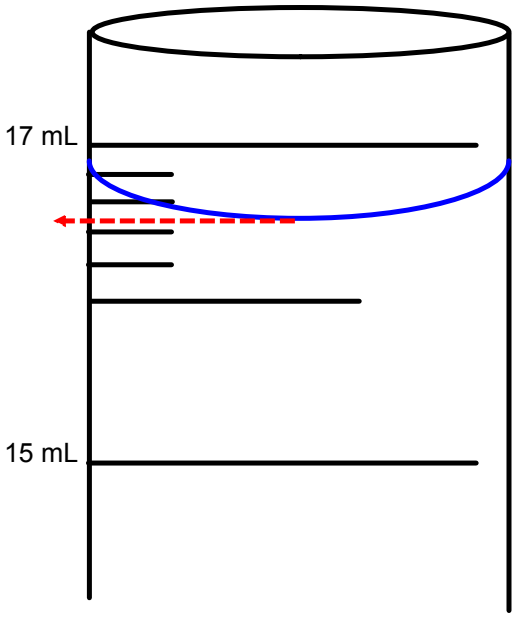
4. **Balance:** teacher will discuss proper use

5. **Probes and Sensors:** teacher discuss proper use

Measuring Rules:

a. Place value to 3rd decimal point
b. Label with proper units
c. Focus on accurate measurements
d. Calibrate equipment before and after use

25 mL Graduated Cylinder



16.47

Text	Symbol	Factor
tera	T	1000000000000
giga	G	1000000000
mega	M	1000000
kilo	k	1000
hecto	h	100
(none)	(none)	1
deci	d	0.1
centi	c	0.01
milli	m	0.001
micro	μ	0.000001
nano	n	0.000000001
pico	p	0.000000000001

Quantity	Dimension	SI unit and symbol	Legacy unit and symbol	Conversionf actor
Time	T	second (s)	second (s)	1
Length	L	metre (m)	centimetre (cm) ångström (Å)	0.0110−-10
Mass	M	kilogram (kg)	gram (g)	0.001
Electric current	I	ampere (A)	international ampereabam pere or biotstatampe re	1.00002210. 03.335641×1 0−-10
Temperature	ΘT	kelvin (K) degree Celsius (°C)	centigrade (°C)	[K] = [°C] + 273.151
Luminous intensity	J	candela (cd)	international candle	0.982
Amount of substance	N	mole (mol)	No legacy unit	n/a
Area	L2	square metre (m2)	\\l "Are"are (are)	100
Acceleration	LT−2	(m•s−2)	gal (gal)	10−2
Frequency	T−-1	hertz (Hz)	cycles per second	1
Energy	L2MT−2	joule (J)	erg (erg)	10−-7
Power	L2MT−-3	watt (W)	(erg/s) horsepower (HP) Pferdestärke (PS)	10−-7745.77 35.5
Force	LMT−-2	newton (N)	dyne (dyn) sthene (sn) kilopond (kp)	10−-51039.8 0665
Pressure	L−-1MT−-2	pascal (Pa)	barye (Ba) pieze (pz) atmosphere (at)	0.11031.013 25×105
Electric charge	IT	coulomb (C)	abcoulombst atcoulomb or franklin	103.335641× 10−-10
Potential difference	L2MT−-3I −-1	volt (V)	international voltabvoltsta tvolt	1.0003410−- 82.997925×1 02
Capacitance	L−-2M −-1T4I2	farad (F)	abfaradstatfa rad	1091.112650 ×10−-12
Inductance	L2MT−-2I −-2	henry (H)	abhenrystath enry	10−-98.9875 52×1011
Electric resistance	L2MT−-3I −-2	ohm (ΩO)	international ohmabohmst atohm	1.0004910−- 98.987552×1 011
Electric conductance	L−-2M −-1T3I2	siemens (S)	international mho (ʊ?) abmhostatm ho	0.999511091 .112650×10− -12
Magnetic flux	L2MT−-2I −-1	weber (Wb)	maxwell (Mx)	10−-8
Magnetic flux density	MT−-2I−-1	tesla (T)	gauss (G)	1×10−-4
Magnetic field strength	IL−-1	(A/m)	oersted (Oe)	103/4πp = 79.57747
Dynamic viscosity	ML−-1T−-1	(Pa•s)	poise (P)	0.1
Kinematic viscosity	L2T−-1	(m2•s−-1)	stokes (St)	10−-4
Luminous flux	J	lumen (lm)	stilb (sb)	104
Illuminance	JL−-2	lux (lx)	phot (ph)	104
[Radioactive] activity	T−-1	becquerel (Bq)	curie (Ci)	3.70×1010
Absorbed [radiation] dose	L2T−-2	gray (Gy)	roentgen (R) rad (rad)	≈0.01HYPE RLINK \\l "cite_note-1 02"[Note 8] 0.01
Radiation dose equivalent	L2T−-2	sievert	roentgen equivalent man (rem)	0.01
Catalytic activity	NT−-1	katal (kat)	No legacy unit	n/a

Ruler Game Activity

http://www.globalclassroom.org/rulergame200/index.html

Measurement Lecture

1) **Sample Size:** the number of tests or subjects in the experiment

2) **Sampling Error:** Too few subjects or observaons invalidang results of experiment

3) **Generalizing:** saying research is true of the enre populaon; need large enough sample size

4) **Averaging:** in order to get an accurate measurement sciensts average mulple data points.

a. data points divided by total size

i. What you measure / Total possible = Average

e.g., 100 ⟌ 75 = .75 or 75%

100 Pennies Activity

1. Mix/toss 10 Pennies
2. Mix/toss 100 Pennies

Explain your results using the vocabulary.

a. Sampling size
b. Sampling error
c. Generalizing
d. Average (average of 2 tosses)

Finding Density Activity

1. Find Mass (i.e., weight) of block
    a. unit in grams (g)
2. Put 15 mL in graduated cylinder
3. Measure displacement
    a. dif. between no block & block
    b. change mL to cm^3

4. Mass (g)/ Volume (cm^3)= Density (g/cm^3)