

Nature of Science - Measurement and Scientific Tools

Vocabulary:

<ul style="list-style-type: none"> Description Explanation 	<ul style="list-style-type: none"> International System of Units (SI) Significant digits
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Description and Explanation:

- A **description** is a spoken or written summary of observations
 - Qualitative description** - use your senses to describe and observation
 - Quantitative description** - use numbers and measurements to describe an observation
- An **explanation** is an interpretation of observations
- Sharing scientific information with scientists in other parts of the world used to be difficult because they all used different units of measurement

International System of Units (SI)

- System of measurement that is internationally accepted for measurement.
- Eliminate confusion between scientists
- Base Unit is most common unit used

SI Base Units		
Quantity Measured	Unit	Symbol
Length	Meter	m
Mass	Kilogram	kg
Time	Second	s
Electric Current	Ampere	A
Temperature	Kelvin	K
Amount of substance	Mole	mol
Intensity of light	Candela	cd

- SI Prefixes are used to identify the size of a unit. (fraction or multiple of ten)

SI Prefixes	
Prefix	Meaning
Mega- (M)	1,000,000 (10^6)
Kilo- (k)	1,000 (10^3)
Hecto- (h)	100 (10^2)
Deka- (da)	0.1 (10^{-1})
Centi- (c)	0.01 (10^{-2})
Milli- (m)	0.001 (10^{-3})
Micro- (μ)	0.000 001 (10^{-6})

To convert SI Units, you must multiply or divide by a factor of ten.

Examples:

1. A book has a mass of 1.1kg. Find the mass of the book in grams.

*Using the table, we can see that one kg is 1,000 times greater than 1 g. So, there are 1,000g in 1kg.

Set up proportion:

2. A rock has a mass of 17.5 grams. Convert the measurement to kilograms.

3. A dosage of medicine is 325 mg. What is the dosage in grams?

Conversions



(picture drawn in class)

All measurements have some uncertainty.

- The tools we use to take measurements can **limit** the accuracy of the measurements.
- Scientists test other's work (our experiments must be replicable), they must record numbers that support the original data.

Significant digits: number of digits in a measurement that you know with a certain degree of reliability.

When scientists analyze **numbers** in their data, values commonly used are:

- **Median** - middle number; if you have an even number of data items, add the middle two numbers and divide by 2
- **Mean** - sum of numbers divided by total number of data entries
- **Mode** - number or item that appears the most
- **Range** - difference between the greatest number and the smallest number

Significant Digit Rules

1. All nonzero numbers are significant.
2. Zeros between nonzero digits are significant.
3. One or more final zeros used after the decimal point are significant.
4. Zeros used solely for spacing the decimal point are NOT significant. The zeros only indicate the position of the decimal point.

*The highlighted numbers in the examples are the significant digits.

Number	Significant Digits	Applied Rules
1.234	4	1
1.02	3	1,2
0.200	3	1,3
1,002	4	1,2
0.001	1	1,4
50,600	3	1,2,4
0.012	2	1,4

Mean, Median, Mode, and Range Practice

Data: 1,2,5,2,3,5,5,6,1,4	Median: $3+4=7$ $7/2= 3.5$
Put in numerical order: 1,1,2,2,3,4,5,5,5,6	Mean: $1+1+2+2+3+4+5$ $+5+5+6= 34$ $34/10= 3.4$
Number data entries: 10	Mode: 5 appears most Range: $6-1 = 5$

Scientific Tools:

- *Science journal*- used to record observations, questions, hypothesis, data, and conclusions from investigations.
- *Rulers and metersticks* - used to measure lengths and distances; SI unit is meter (m)
- *Graduated cylinders*- measure the volume of a liquid; typical SI units are liters (L) or milliliters (mL)
- *Triple beam balance*- used to measure the mass of an object; mass is measured in grams (g) or kilograms (kg)
- *Thermometer*- used to measure the temperature of a substance
- *Computers*- used to collect, organize, and store information about a topic or scientific investigation

Tools Used by Earth Scientists

- *Binoculars*- enable people to view faraway objects
- *Compass*- shows magnetic north and is used to navigate in the field
- *Wind vane*- often attached to roofs of buildings, rotates to show wind direction
- *Anemometer*- used to measure speed and force of wind
- *Streak plate*- piece of hard, unglazed porcelain that helps you identify minerals

Key Concept Check

1. Why is it important for scientists to use the International System of Units?

Significant Digits, Mean, Median, Mode, Range

2. What causes measurement uncertainty?

3. What are mean, median, mode, and range?
When are they used?