Foundational Knowledge

Auburn Mountainview

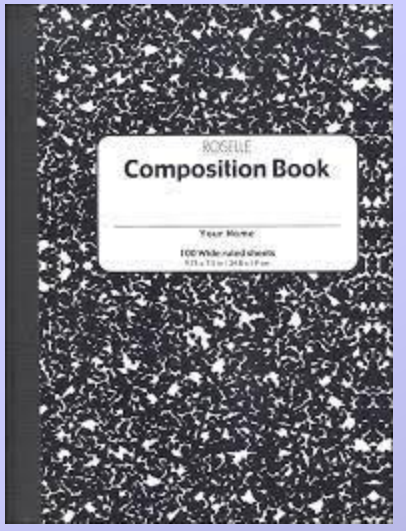
Karl Steffin, 2010

7/29/2026

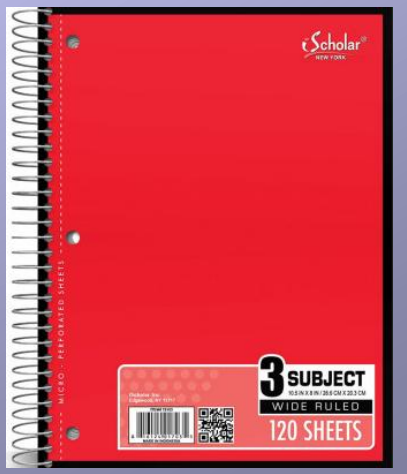
Class Structure

- Notes and Calendar found online at www.steffin.us.
- Graded work found and submitted to classroom.
  - Due by midnight unless specifically stated.
  - No excuses for internet issues/absences within 24 hours.
    - If conflicts are known in advance email me.
- If absent, assessments will be taken next day back unless prior arrangement is made.
- Other procedures: Class Syllabus (steffin.us)

Guided Notes



- **Handwrite all notes in a composition book.**
  - **Do not use a spiral journal.**
  - **Pictures do not need to be copied.**
- **This needs to be done before class discussion**
  - **Marked PowerPoint on calendar.**
  - **Chapter notes can be graded (first few chapters for sure)**
- **I do not provide one-on-one help if you have not completed the unit notes first.**



Everything Beyond this Title

- **Any text in red or areas in a red box is not needed in your notes.**
- **While this entire PPT is not required to be in your notes, you may want to still write any material you don’t have a firm grasp on.**
- **If you write anything from here add the title of the PPT (first slide) and highlight it.**

Math

- **Basic Algebra: In class formulas will be presented.**
  - **All but the variable to solve for should be given/known.**
    - **GUESS Method should be used when possible.**
    - **Isolate the variable.**
    - **Solve using (P E MD AS).**
  - **Use correct significant digits.**
  - **Final answers highlighted or boxed.**

Math (Significant Digits: SD)

- **Is Significant**
  1. **Non zero's.**
  2. **Zero's after a decimal and after a significant number.**
  3. **Zero's between significant numbers.**
  4. **Scientific Notation: all numbers before the *x*.**
- **Is Not Significant**
  1. **Zero's after a significant number with no decimals.**
  2. **Zero's after a decimal before the first significant number.**

Math (Significant Digits: Examples)

- **Is Significant**
  1. **4687.9 (5 SD)**
  2. **1.0 (2 SD)**
  3. **1003 (4 SD)** **10.0 (3 SD)**
  4. **6.25×10^{23} (3 SD)**
- **Is Not Significant**
  1. **12000 (2 SD)**
  2. **0.002 (1 SD)**

Math (Significant Digits: Algebra)

- **Adding and subtracting:**
  - **When adding or subtracting numbers, the answer should be rounded to the same number of decimal places as the number with the fewest decimal places.**
- **Multiplying and Dividing:**
  - **When multiplying or dividing, the result should be rounded to the same number of significant figures as the number with the least number of significant figures**

Math (Significant Digits: Algebra)

- **Adding and subtracting:**

$$\begin{array}{r} 16.086 \\ +\ 18.26 \\ \hline 34.35 \end{array} \qquad \begin{array}{r} thousandth \\ +\ \text{hundredth} \\ \hline \text{hundredth} \end{array} \qquad \begin{array}{r} 14 \\ -\ 0.9 \\ \hline 13 \end{array} \qquad \begin{array}{r} Ones \\ -\ tenths \\ \hline Ones \end{array}$$

- **Multiplying and Dividing:**

$$\begin{array}{r} 5.7 \\ x\quad 8.55 \\ \hline 49 \end{array} \qquad \begin{array}{r} 2\ SD \\ x\ 3\ \text{SD} \\ \hline 2\ SD \end{array} \qquad \begin{array}{r} 25005 \\ \div\ 8 \\ \hline 3000 \end{array} \qquad \begin{array}{r} 5\ SD \\ \div\ 1\ \text{SD} \\ \hline 1\ SD \end{array}$$

Math (Algebra)

- **What is the volume of a cube which has sides of 3.0-cm, 5.0-cm and 10.0-cm respectively?**

$$V = lwh$$

$$V = (3.0 - cm)(5.0 - cm)(10.0 - cm)$$

$$V = 150.0 - cm^3$$

$V =$

l= 3.0-cm

w= 5.0-cm

h= 10.0-cm

$$\boxed{V = 150 - cm^3}$$

Math (Variable Isolation)

- **What is the radius of a 1000-cm^3 sphere?**

$$V = \frac{4}{3}\pi r^3 \rightarrow r = \left(\frac{3}{4\pi}V\right)^{\frac{1}{3}} \text{ or } \sqrt[3]{\frac{3}{4\pi}V} \qquad V = 1000 - cm^3$$

$$r =$$

$$r = \left(\frac{3}{4\pi} \cdot 1000 - cm^3\right)^{\frac{1}{3}}$$

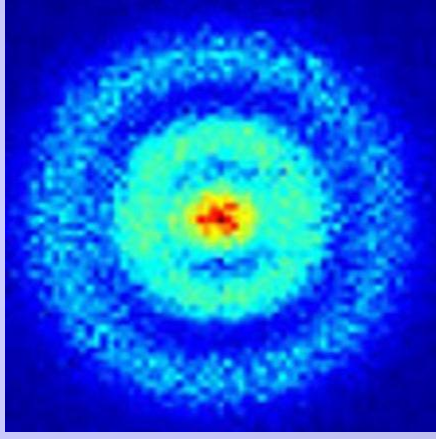
$$r = \left(\frac{3}{4\pi} \cdot 100 - cm^3\right)^{\frac{1}{3}}$$

$$r = (238.7\ldots - cm^3)^{\frac{1}{3}}$$

$$r = 6.203\ldots - cm$$

$$\boxed{V = 6 - \ cm^3}$$

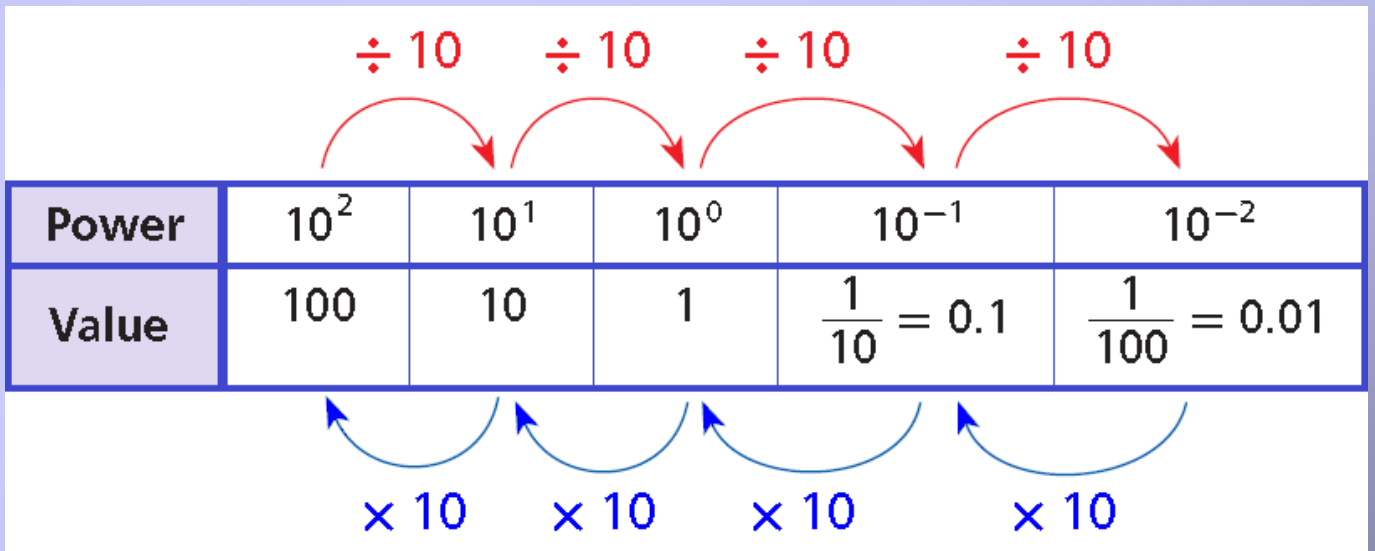
Scientific Notation (SN)



- **Scientific Notation uses exponents ($x\ 10^{x}$).**
- **Width of the universe ≈ 93 billion light years:**
  - **879,800,000,000,000,000,000,000,000-m can be simplified by moving the decimal 26 places to the left.**
  - **This is written as $8.8\ x\ 10^{26}$-m.**
- **Width of a Hydrogen atom ≈ 0.000 000 000 11-m:**
  - **Simplify by moving the decimal 10 places to the right.**
  - **This is written as $1.1\ x\ 10^{-10}$-m (1-Å: Angstrom).**

Scientific Notation (SN)

- **Large #: Count decimal movement to the left.**
  - **Positive exponent (x10): $10^3 = 10x10x10 = 1000$**
- **Small #: Count decimal movement to the right.**
  - **Negative exponent (÷10): $10^{-3} = \frac{1}{10} \times \frac{1}{10} \times \frac{1}{10} = 1/1000$**



SN Examples (with 3 Significant Digits)

$12{,}345 – 1.2345 \times 10^{4}$	1.23×10^{4}
$6{,}789{,}012 – 6.789012 \times 10^{6}$	6.79×10^{6}
$3{,}456 – 3.456 \times 10^{3}$	3.46×10^{3}
$78{,}901{,}234 – 7.8901234 \times 10^{7}$	7.89×10^{7}
$98.76 – 9.876 \times 10^{1}$	9.88×10^{1}
$0.000\ 000\ 01 – 1 \times 10^{-8}$	1.00×10^{-8}
$0.001\ 027 – 1.027 \times 10^{-3}$	1.03×10^{-3}

Scientific Notation and Math

- $a \times 10^{c} + b \times 10^{c} = (a + b) \times 10^{c}$
- $a \times 10^{c} - b \times 10^{c} = (a - b) \times 10^{c}$
- $a \times 10^{c} \bullet b \times 10^{d} = a \bullet b \times 10^{(c + d)}$

$4 \times 10^{5} \bullet 2 \times 10^{3}$ $\quad 4 \bullet 2 \times 10^{(5 + 3)}$ $\quad \boxed{8 \times 10^{8}}$

$3.0 \times 10^{6} \bullet 5 \times 10^{-3}$ $\quad 15 \times 10^{(6 + (-3))}$ $\quad \boxed{1.5 \times 10^{4}}$

- $a \times 10^{c} / b \times 10^{d} = a / b \times 10^{(c - d)}$

$\frac{11 \times 10^{7}}{2 \times 10^{4}}$ $\quad \frac{11}{2} \times 10^{7-4}$ $\quad \boxed{6 \times 10^{3}}$

$\frac{3 \times 10^{3}}{9 \times 10^{5}}$ $\quad \frac{3}{9} \times 10^{3-5}$ $\quad .3 \times 10^{-2}$ $\quad 3.33 \times 10^{-2-1}$ $\quad \boxed{3 \times 10^{-3}}$

Scientific Notation Base 3

- **There is a shortcut if the exponent is a multiple of 3:**

10^{-9}: nano-n **An atoms size is around 10-nm**

10^{-6}: micro-μ **Thickness of medium hair is 70-μm**

10^{-3}: milli-m **10 sheets of paper have a thickness of 1-mm**

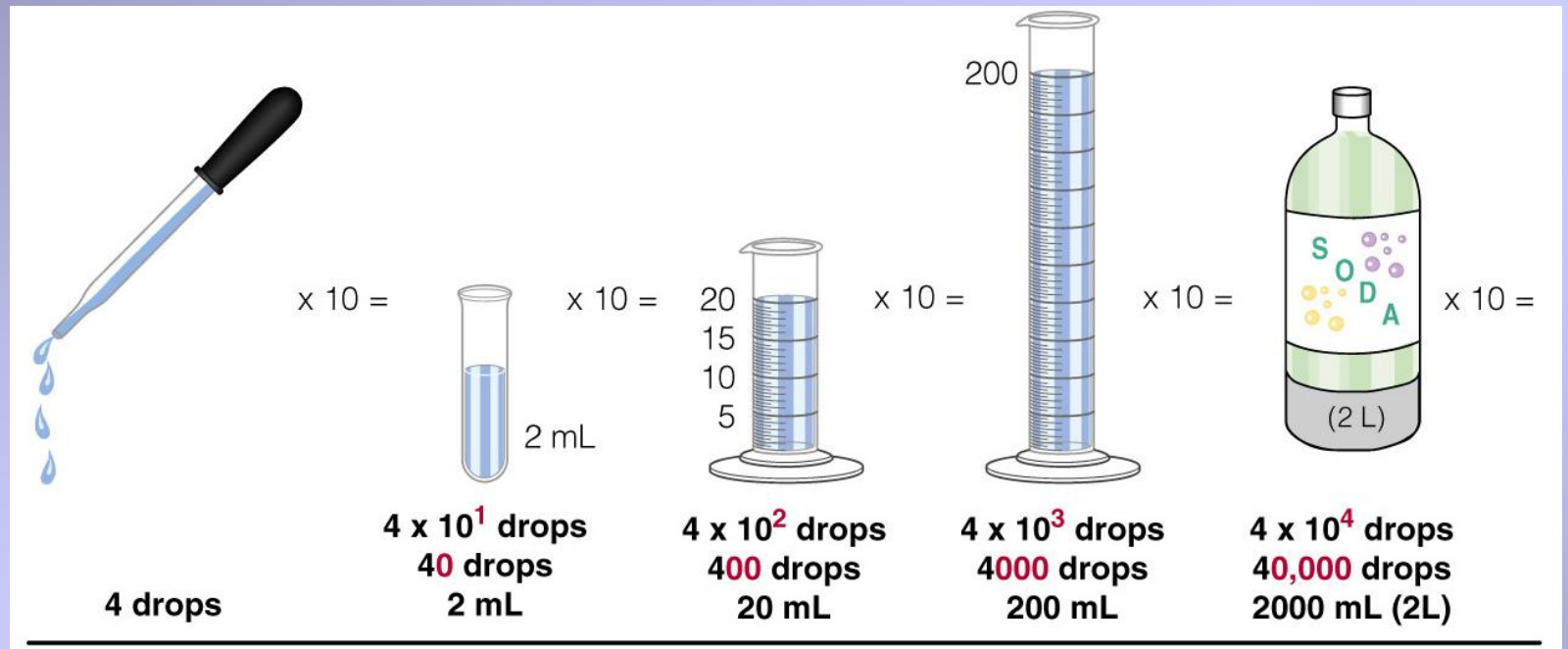
10^{-2}: centi-c **A thumb nail averages 2-cm**

10^{-1}: deci-d **A dragonfly has a wingspan of 2-dm**

10^{3}: Kilo-k **HS Cross-Country races are 5-km**

10^{6}: Mega-M **Montana has a width of 1-Mm**

Base 10 Visual



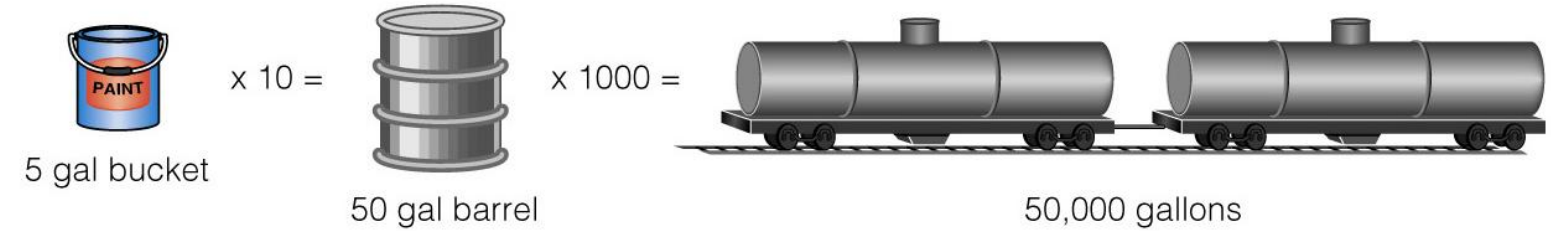
4 drops

4×10^1 drops
40 drops
2 mL

4×10^2 drops
400 drops
20 mL

4×10^3 drops
4000 drops
200 mL

4×10^4 drops
40,000 drops
2000 mL (2L)



5 gal bucket

50 gal barrel

50,000 gallons

4×10^5 drops
400,000 drops
20 liters

4×10^6 drops
4,000,000 drops
200 liters

4×10^9 drops
4,000,000,000 drops
200,000 liters

Math: Percentage

- **A ratio of part to whole.**
- **On a calculator will be in decimal form.**
  - **x100 for final answer (.956 is 95.6%)**
  - **÷100 to put in calculator (12.5% is .125)**

$$\% = \frac{Part}{Whole}$$

Accuracy and Precision

- **Accuracy: When a measured value is very close to the accepted value.**
  - **Error analysis measures against accuracy.**
- **Precision: When measured values are very close to each other.**
  - **If not accurate: shows consistent error present in data.**

Accuracy ≈ Answer, Precision ≈ Placement

Accuracy v. Precision Visual

No Accuracy

No Precision

Good Accuracy

Good Precision

No Accuracy

Good Precision

***Good* Accuracy**

No Precision

Which is Better?

- **Having a high degree of precision without accuracy shows that there is probably a variable affecting the outcome that is being overlooked.**
- **As for accuracy, remember even a broken clock shows the correct answer twice a day.**
- **It is best to be precisely accurate.**

How to use Accuracy

- **Error Analysis: For quantitative data only.**

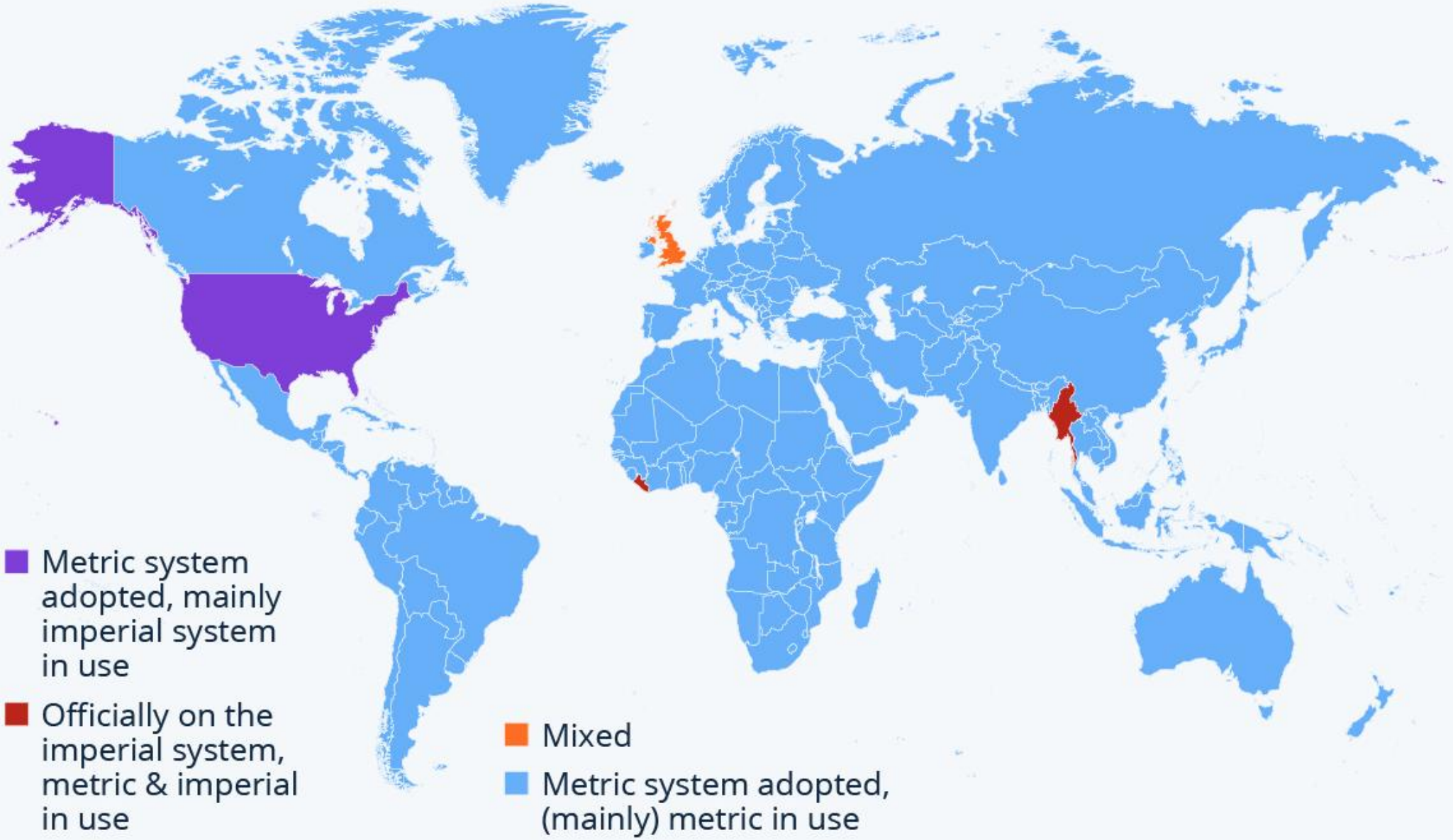
$$\frac{|\text{Measured Value} - \text{Accepted Value}|}{\text{Accepted Ave}}$$

This is a Percentage. (ex: .15266 = 15.3%)

Accepted Values may be given by a teacher, found online, or self calculated.

Units

- **Numbers often have units to describe them (SI)**
  - **Base: Can not be broken down**
    - **Ex: Length = Meter**
  - **Derived: Two units combined (x or ÷)**
    - **Ex: Energy = Joules which is a derived from Force x Distance (Newton x Meter)**
- **In class avoid non SI units.**
  - **Imperial: ft, in, lb…**



In Canada, Australia, India and some other former Commonwealth countries vital statistics, living and commercial spaces, oven temperatures and recipe measurements might still be imperial.

Source: Statista Research

Base Units

- **Mass: Kilogram-Kg or g**
- **Length/Width/Height: Meter-m**
- **Time: Second-s**
- **Chemical Amount: Mole-mol**
- **Temperature: Kelvin-K**
- **Electric Current: Ampere-A**
- **Luminous Intensity: Candela-cd**

Non SI common Base Units

- **Derived SI Units**
  - **Volume: Volume-m^3 or cm^3**
  - **Energy: Joule-J**
  - **Pressure: Pascals-Pa**
- **Non SI Units**
  - **Volume: Liter-L or mL**
  - **Temperature: Centigrade-C**
  - **Energy: calorie-cal (different than Calorie-Cal)**
  - **Pressure: Atmosphere-atm**

Conversions

- **The internet is not always an option to convert units. Dimensional Analysis is a needed skill:**
  - **Units must be the same type (length, time…)**
  - **Place the old unit opposite where it currently is (numerator or denominator)**
  - **Place the new unit where the old unit currently is.**
  - **Use a conversion/‘truth’ table to find the appropriate numbers (some found on formula sheet).**

Conversions Example

- **How many centimeters in 1.50 feet?**

$$1.5-ft \times \frac{12-in}{1-ft} \times \frac{2.54-cm}{1-in} = \boxed{45.7-cm}$$

- **Convert 60.00-mph to m/s.**

$$60-\frac{mi}{hr} \times \frac{1609.34-m}{1-mi} \times \frac{1-hr}{3600-sec} = \boxed{26.82-\frac{m}{s}}$$