SEAKING MASTERY OF MATTER

UNIT 3 MODULE 1
SI UNITS & DENSITY

Qualitative vs. Quantitative

- Unit 2 covered **qualitative descriptions** of matter. Qualitative descriptions of matter include:
  - Words to communicate the nature of matter, but they do not include numbers.
- This unit focuses on **quantitative descriptions** of matter. Quantitative descriptions of matter include:
  - Numbers to communicate measured quantities.

A example of a qualitative description is "Eevee is soft and fluffy." An example of a quantitative description is "Eevee has a mass of 4 kilograms."

English System of Measurement

- Quantitative data can be reported using various units of measurement.
- English system of measurement:
  - Weight = pounds (lb), ounces (oz)
  - Volume = quarts (qt), pints (pt), cups (c), etc.
  - Temperature = degrees Fahrenheit (℉)
  - Length = inches (in), feet (ft), yards (yd), miles (mi)

Measurements in the Pokémon Go Universe

- However, scientists and Pokémon masters do **NOT** use the English system of measurement.
- Scientists and Pokémon masters use **SI (International System) units** of measurement, which are based on the **metric system**.
- **SI base units of measurement** used in Chemistry:
  - Time = seconds (s)
  - Amount of substance = moles (mol)
  - Length = meters (m)
  - Mass = kilogram (kg)
  - Temperature = Kelvin (K)

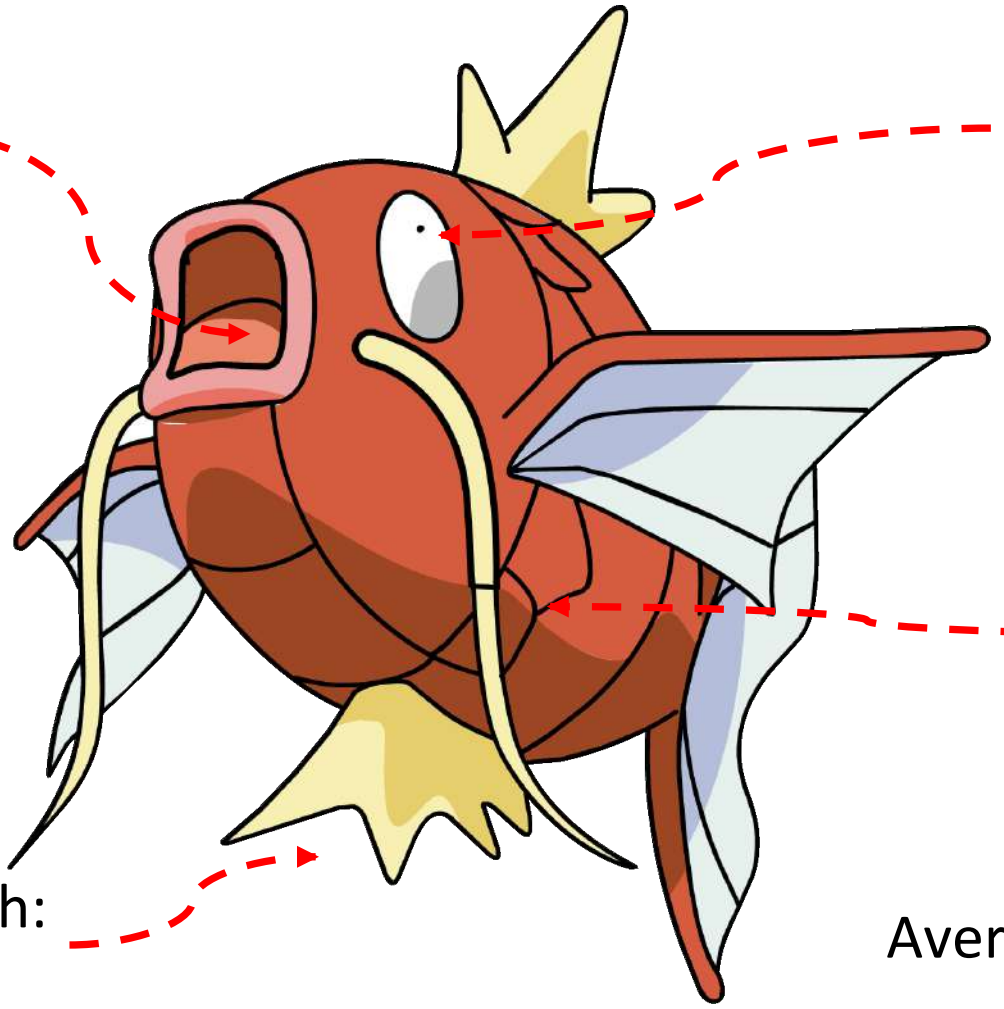
Visualizing SI Units Using Common Household Goods

Length	Volume	Mass
mm = about width of piece of yarn cm = about radius of nickel m = little longer than yard stick km = just over $\frac{1}{2}$ mile	mL = about $\frac{1}{4}$ teaspoon L = about 1 quart; $\frac{1}{2}$ of 2 L bottle of soda *1 mL = 1 cm^3 = 1 cc	g = 1 medium paper clip; 1 dollar bill kg = almost 2 pounds; bag of brown sugar

Measuring a Pokémon with Base SI Units

Ingests an average of
2 moles (mol) of H_2O
every second

Average time it takes for
Magikarp to evolve:
It's over 9000 seconds (s)!!



Average body
temperature:
277 Kelvin (K)

Average ventral fin length:
0.1 meters (m)

Average mass: 1 kilogram (kg)

WOW! That Onix has a mass of 1 Megagram (Mg)!

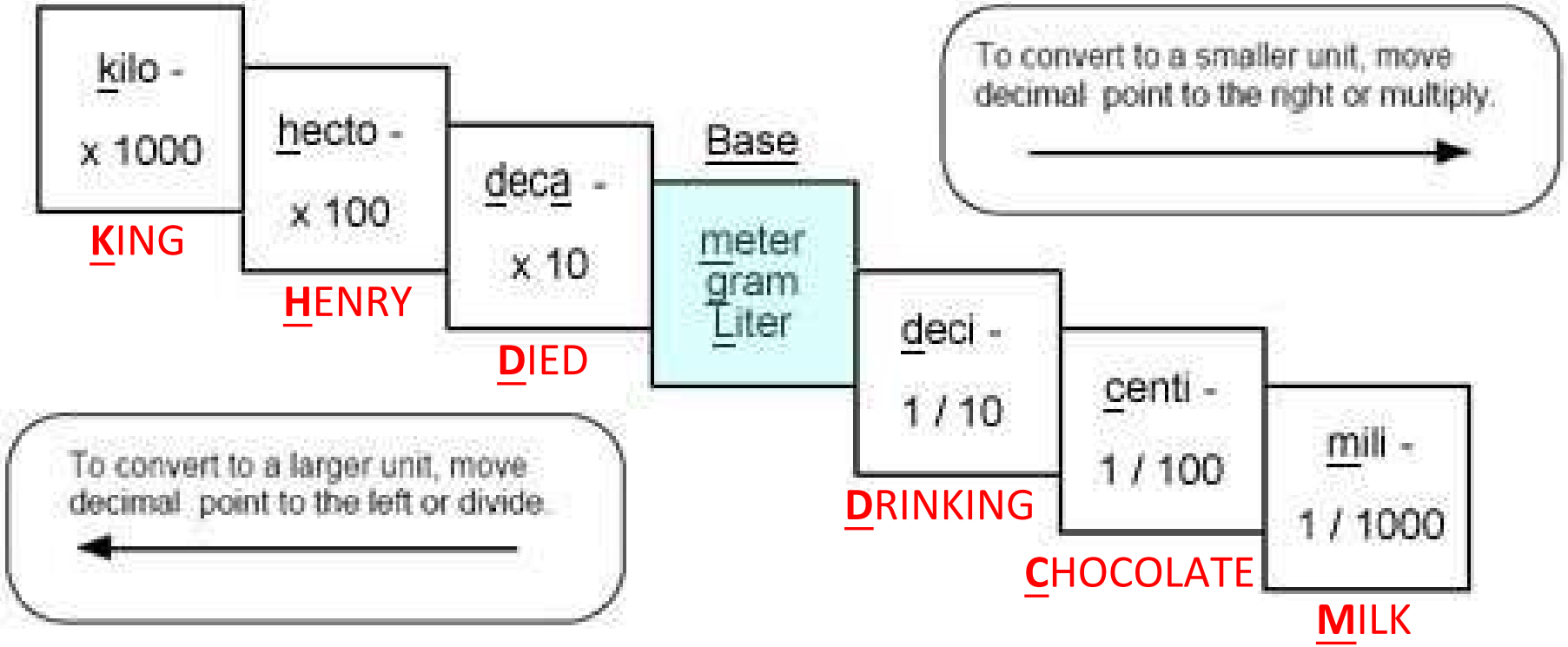
Note:
1 Mg = 10^6 g
= 1,000,000 g

TABLE 1.4 Some Prefixes for Multiples of SI Units

Factor	Prefix	Symbol	Example
$1{,}000{,}000 = 10^6$	mega	M	1 megameter (Mm) = 10^6 m
$1{,}000 = 10^3$	kilo	k	1 kilogram (kg) = 10^3 g
$100 = 10^2$	hecto	h	1 hectogram (hg) = 100 g
$10 = 10^1$	deca	da	1 decagram dag) = 10 g
$0.1 = 10^{-1}$	deci	d	1 decimeter (dm) = 0.1 m
$0.01 = 10^{-2}$	centi	c	1 centimeter (cm) = 0.01 m
$0.001 = 10^{-3}$	milli	m	1 milligram (mg) = 0.001 g
$^*0.000\,001 = 10^{-6}$	micro	μ	1 micrometer (μm) = 10^{-6} m

SI Conversions

Metric prefixes are used with base units to indicate the scale of the number.
Imagine a staircase where each step represents a unit prefix.



Derived Units

- Derived units are defined by a combination of units.
  - Volume
    - Equation = (l) x (w) x (h)
    - Units = cm^3 (cc, mL) or dm^3 (L)
    - In another words, 1 cm^3 = 1 cubic centimeter (cc) = 1 milliliters (mL) or 1 dm^3 = 1 liter (L)
  - Density
    - Density = mass/volume or D = m/V
    - Units = kg/m^3, g/mL, or g/cm^3