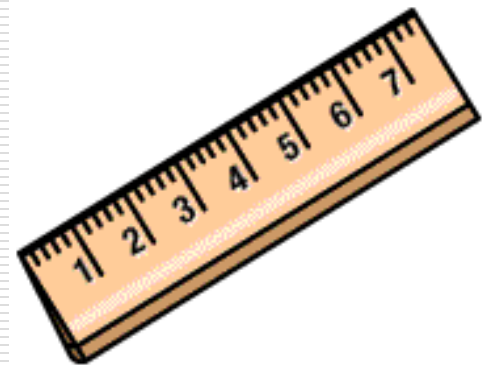


Measuring in the Metric System



Conversion “Starters” For Chemistry

- GOAL: learn to convert, without using a calculator:
 1. milliliters $\leftrightarrow$ liters
 2. milligrams $\leftrightarrow$ grams
 3. millimeters $\leftrightarrow$ centimeters
 4. centimeters $\leftrightarrow$ meters
 5. nanometers $\leftrightarrow$ meters *

AND to be able to do these conversions

- On paper
- In your head

*requires comfort working in scientific notation

Metric system review



United Streaming Video

Metric

Milliliters (ml) → Liters

Milligrams (mg) → gram

Milliliters (ml) → centiliters

Centimeters (cm) → meters

Nanometers (nm) → meters

“The Facts” :

Essential knowledge for our goal:

1000 milliliters = 1 liter

1000 mL = 1 L

1000 milligrams = 1 gram

1000 mg = 1 g

10 milliliters = 1 centiliter

10 mL = 1 cL

100 centimeters = 1 meter

100 cm = 1 m

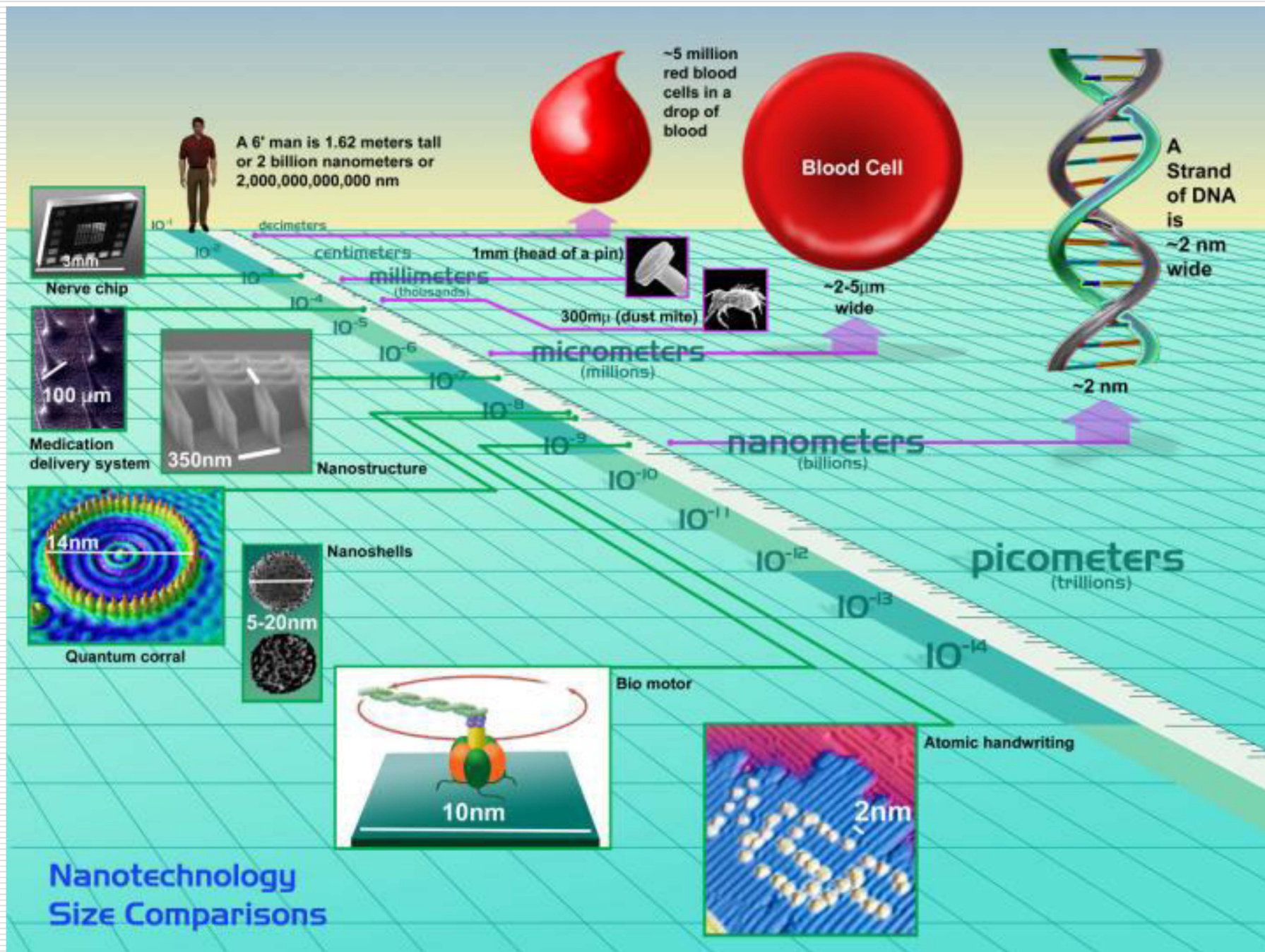
0.001 kilometers = 1 meter

10^{-3} nm = 1 m

The Powers of Ten



From Youtube



1 mole = 6020000000000000000000000

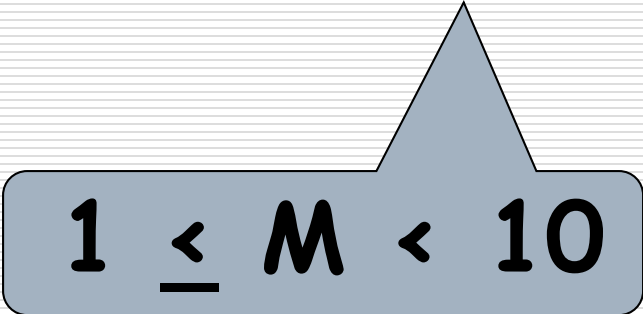
Mass of an electron =

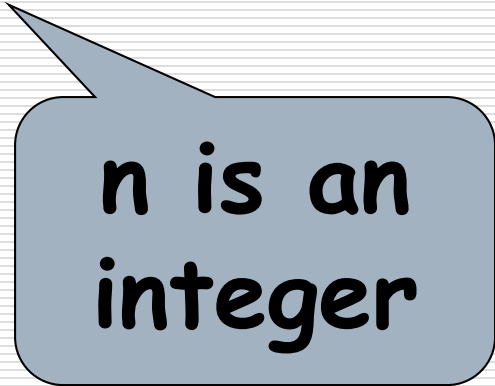
0.00091 kg

Review:

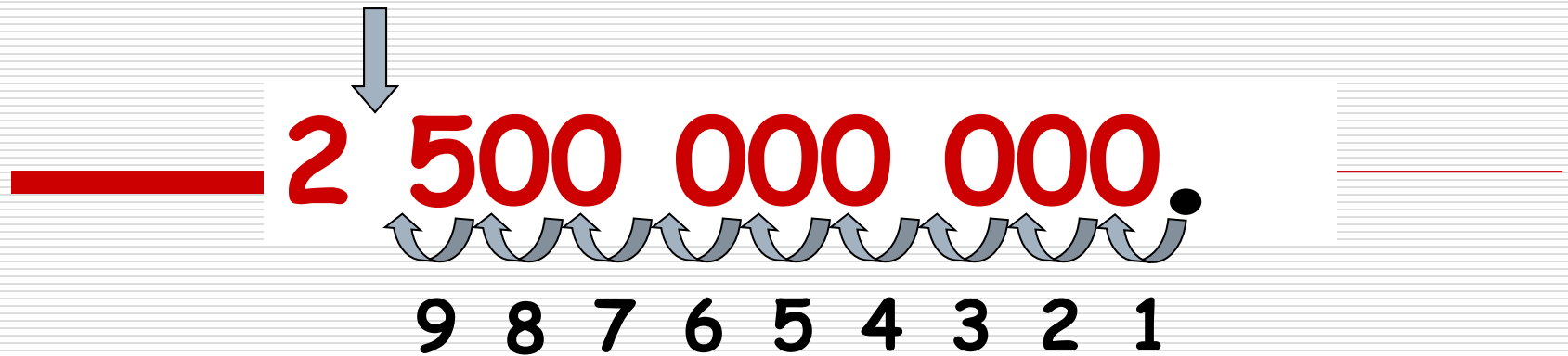
Scientific notation expresses a number in the form:

$$M \times 10^n$$

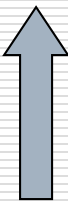

$$1 \leq M < 10$$



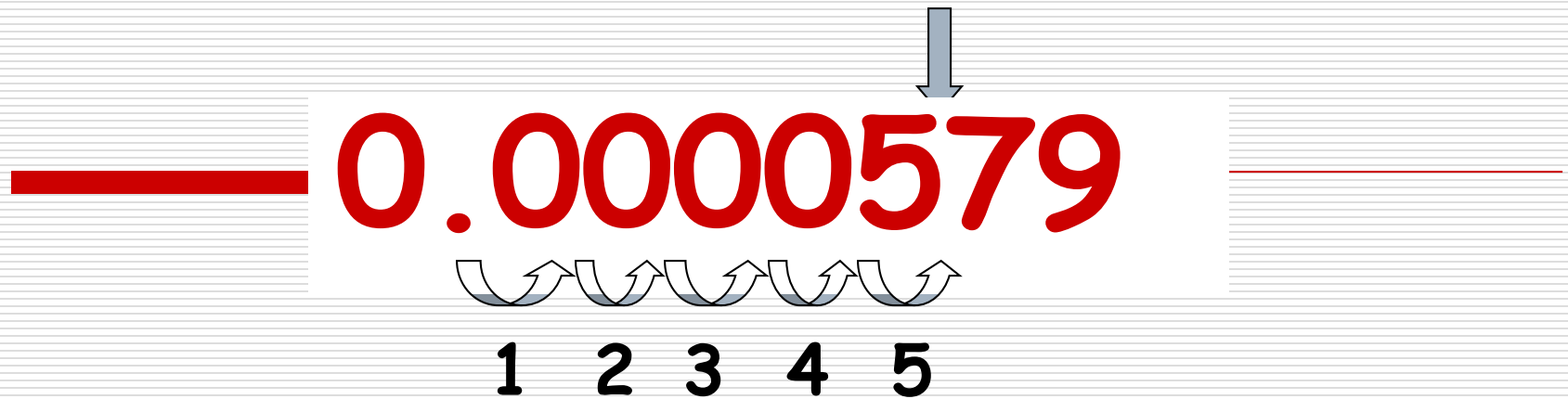
n is an integer



- Step #1: Insert an understood decimal point
- Step #2: Decide where the decimal must end up so that one number is to its left
- Step #3: Count how many places you bounce the decimal point
- Step #4: Re-write in the form $M \times 10^n$

$$2.5 \times 10^9$$


The exponent is the
number of places we
moved the decimal.

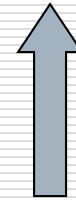


Step #2: Decide where the decimal must end up so that one number is to its left

Step #3: Count how many places you bounce the decimal point

Step #4: Re-write in the form $M \times 10^n$

$$5.79 \times 10^{-5}$$



The exponent is negative because the number we started with was less than 1.

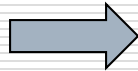
Converting Amounts On Paper

- Any amount has TWO PARTS:
 - The NUMBER (hard to miss)
 - The UNIT (easy at first to ignore)
 - To show the setup for a conversion problem, you need:
 - **Conversion factors, preferably memorized**
 - Your starting amount, with UNIT
 - The UNIT you want your answer to have
-

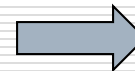
Where Conversion Factors Come From

- ❑ **Conversion factors are math bridges**
- ❑ To get them, you start with **facts**:
- ❑ For example:
 - $100 \text{ cm} = 1 \text{ m}$
- ❑ And now for the math manipulation:
 - Divide each side by 100 cm

$$\frac{100 \text{ cm}}{100 \text{ cm}} = \frac{1 \text{ m}}{100 \text{ cm}}$$



$$1 = \frac{1 \text{ m}}{100 \text{ cm}}$$



Conversion factor in its usable form

A light blue arrow pointing downwards from the text 'Conversion factor in its usable form' to the boxed equation.
$$\frac{1 \text{ m}}{100 \text{ cm}}$$

It's ok to flip a conversion factor

$$\frac{1 \text{ m}}{100 \text{ cm}} \text{ is the same as } \frac{100 \text{ cm}}{1 \text{ m}}$$

□ This works because

■ $100 \text{ cm} = 1 \text{ m}$

□ And we can manipulate from the right side this time:

Conversion factor in its usable form



$$\frac{100 \text{ cm}}{1 \text{ m}} = \frac{1 \text{ m}}{100 \text{ cm}} \longrightarrow \frac{100 \text{ cm}}{1 \text{ m}} = 1 \longrightarrow$$

$$\frac{100 \text{ cm}}{1 \text{ m}}$$

Write your own conversion factors

- ☐ Each of your essential facts for this lesson can be used to write TWO conversion factors
 - ☐ Use your essential facts to list the conversion factors NOW
-

Generic One-Step Conversion Problem Setup

1. List the given amount (with units)
2. Set up a “blank” fraction next to it
3. Put the unit from your **given amount** in the **bottom** of the blank fraction
4. Put the **unit you want your answer to have** in the **top** of the blank fraction

$$\left[\text{GIVEN AMOUNT \& UNIT} \right] \left[\frac{\text{ANSWER UNIT}}{\text{UNIT}} \right] =$$

Finish the job!

- ❑ Find the conversion factor that matches this second fraction
- ❑ Put in the numbers and solve!
- ❑ Example: Convert 1.2 m to cm
 - Write given amount and unit
 - Put given unit in the bottom of the next fraction
 - Put the answer unit in the top
 - Find the conversion factor:
 - Solve, cancelling units
 - Answer = 120 cm

$$\frac{100 \text{ cm}}{1 \text{ m}}$$

Conversion factors

□ $100 \text{ cm} = 1 \text{ m}$

■ or $1 \text{ cm} = 0.01 \text{ m}$

□ $1000 \text{ mm} = 1 \text{ m}$

■ or $1 \text{ mm} = 0.001 \text{ m}$

□ $1 \text{ km} = 1000 \text{ m}$

■ or $0.001 \text{ km} = 1 \text{ m}$

Practice These Conversions On Paper

□ Use the setup we just described:

■ $765 \text{ mg} = ? \text{ g}$

■ $0.85 \text{ L} = ? \text{ mL}$

■ $182 \text{ cm} = ? \text{ m}$

■ $300 \text{ mm} = ? \text{ cm}$
