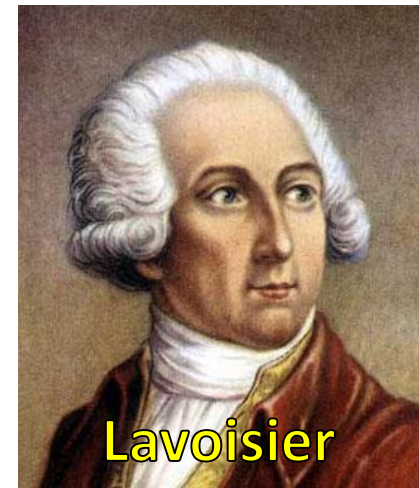# The Metric System

The **metric system** is an **internationally agreed** **decimal** (based on power of 10) system of measurement. It was originally introduced by France in 1799.

Modern **"Metric system"** term is a synonym for **"SI"** or the **"International System of Units"** **(1960)**—the **official system of measurement** in almost every country in the world.

Le Système international d'unités
The International System of Units
SI

Origin of the Metric System

- **Idea of standardized system of measurement based on the decimal was first proposed <u>as early as ~1670</u>.**

- **The first practical implementation was carried out by French Revolutionaries towards the end of the 18th century.**

- **In 1790 a committee** (including mathematicians **Laplace** and **Legendre**, and chemist **Lavoisier**) **was appointed to develop a unified, natural, universal system of measurement.**

Laplace

Legendre

Lavoisier

It was called the "metric" system (French for *measure*).

Metric System Basics

- **The __metric system__** was built around **__three base units__** that corresponded to a **certain kind of measurement:**

  - ➢ **Length** = **meter**
  - ➢ **Volume** = **liter**
  - ➢ **Weight (Mass)** = **gram**

- **The base units** were derived from the **natural world:** the *dimensions of the Earth* and *properties of water*.

- **__Decimal multiplicative prefixes__** were added to base units to make up the **full range** of metric system:

  - ➢ **milli** + **meter** = **millimeter**
  - ➢ **kilo** + **gram** = **kilogram**
  - ➢ **nano** + **liter** = **nanoliter**
 - ➢ **micro** + **meter** = **micrometer**

Prototypes

Historically, **prototypes** ("originals") of base units were kept in the *Archives Nationales* **in France** with **copies manufactured and distributed** among other countries - members of The Metre Convention of 1875 (and subsequent conventions).

1799: Mètre des Archives (Platinum Bar)

1799 platinum bar known as *le mètre des Archives*
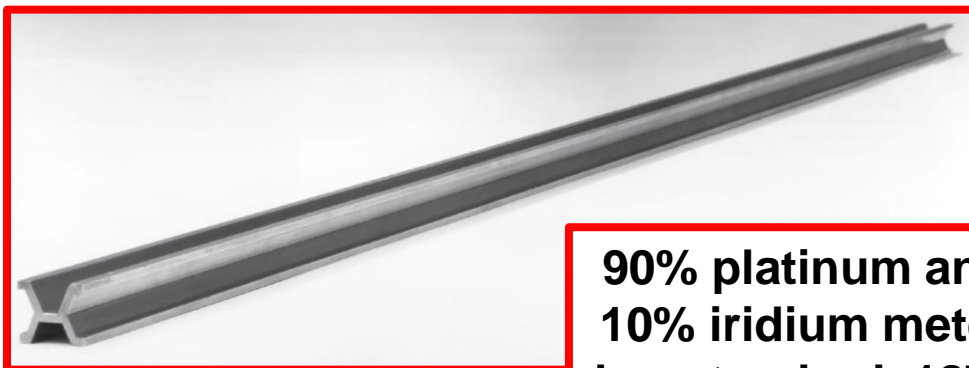
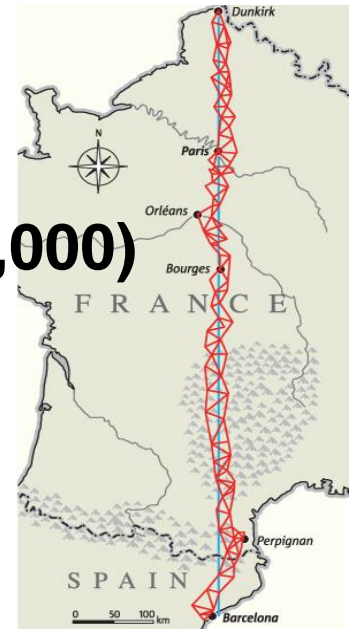**90% platinum and 10% iridium meter bar standard, 1875**
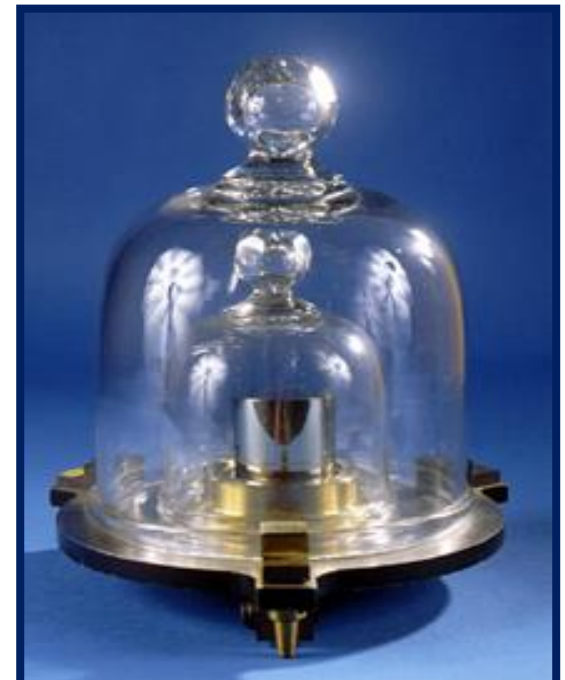
IPK, International Prototype Kilogram

Original Definitions

1. **Meter** (length) **- one ten millionth (1/10,000,000) of the quarter of the Earth's meridian*.**

   *determined based on the 1792-1798 survey of the length of the Earth's meridian between Dunkirk (51°N) and Barcelona (41°N) through Paris.

2. **Gram** (mass) **- the mass of one cubic centimeter of water at the melting point of water.**

3. **Second** (time) **- 1/86,400 of a mean solar day** *(redefined later as the fraction 1/31,556,925.9747 of the tropical year 1900)***.**

4. **Degree Centigrade** (temperature) - obtained by assigning **0°C to the freezing point of water** and **100°C to the boiling point of water.**

Fundamental SI Units

As Metric System evolved into the **SI system**, **seven** **mutually independent fundamental units** have been selected:

1. **Meter** (length)

2. **Kilogram** (mass)

3. **Second** (time)

4. **Kelvin** (temperature)

5. **Ampere** (electric current)

6. **Candela** (luminous intensity)

7. **Mole** (amount of elementary entities like atoms or molecules)

On May 20, 2019, all seven have been redefined based on *fundamental physical constants*.
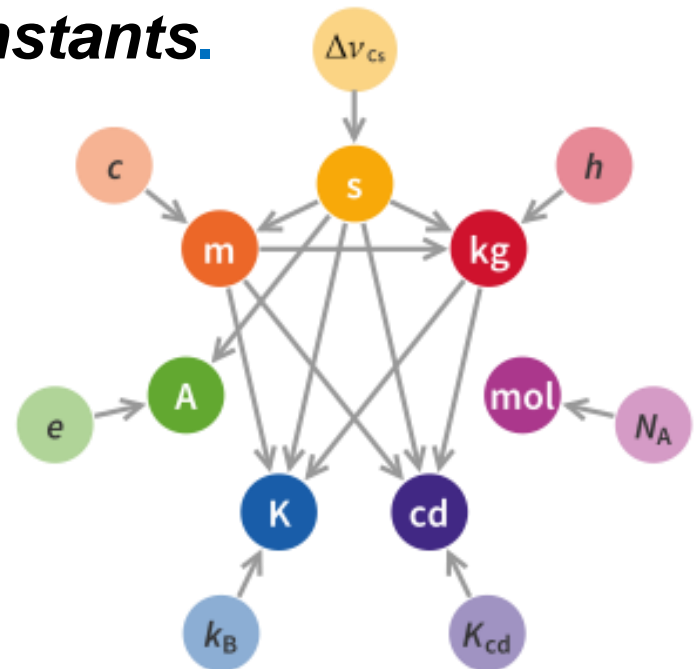
Prefixes in Metric System

Prefix	Symbol	Factor	
tera	T	1000000000000	10^{12}
giga	G	1000000000	10^{9}
mega	M	1000000	10^{6}
kilo	k	1000	10^{3}
hecto	h	100	10^{2}
deca	da	10	10^{1}
(none)	(base unit)	1	10^{0}
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro	μ	0.000001	10^{-6}
nano	n	0.000000001	10^{-9}
pico	p	0.000000000001	10^{-12}

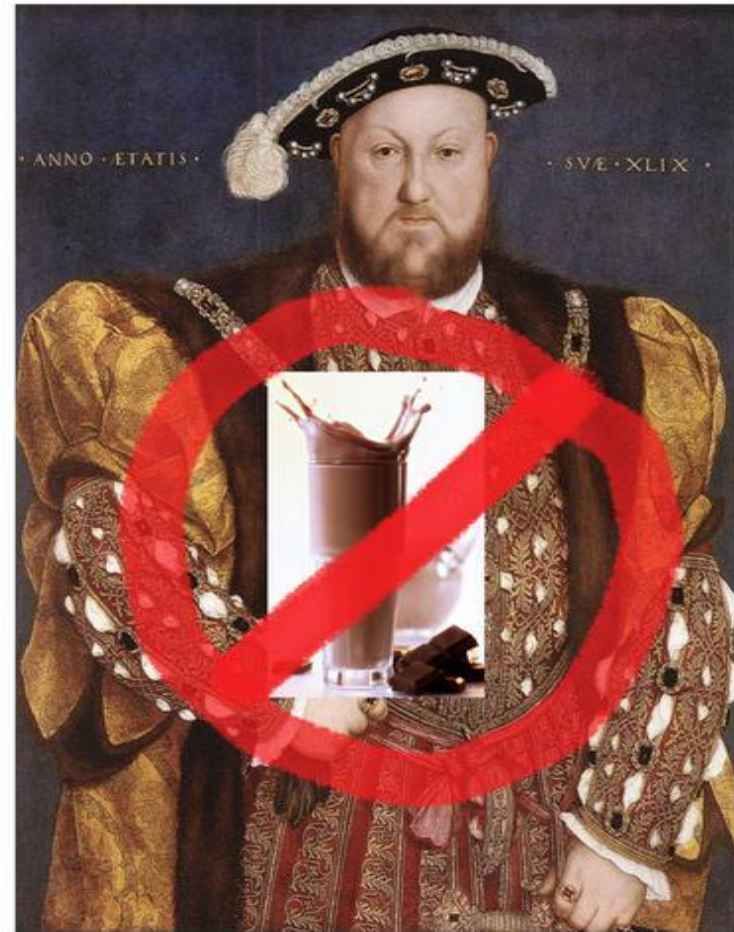# What is the order of the metric system?

- **King Henry Died by Drinking Chocolate Milk**

larger

– King: **Kilo**

– Henry: **Hecto**

– Died: **Deca**

– By: **Base** (m, L, g)

– Drinking: **Deci**

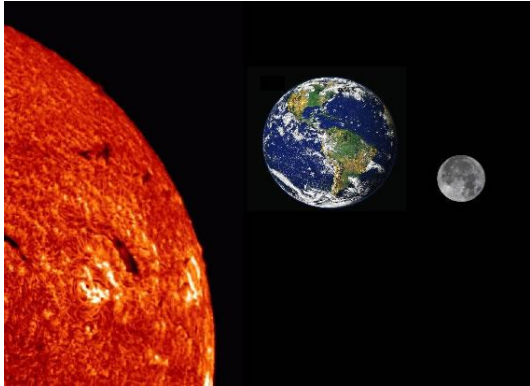– Chocolate: **Centi**

– Milk: **Milli**

smaller

Metric Examples

Any US paper currency note ($1, $5, $10, $20) has a mass of 1 g; the mass of a nickel is 5 g; the mass of a penny is 2.5 grams.
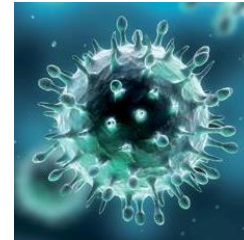
A typical doorknob is ~1 m high.

The mass of the Earth is 6×10^{24} kg; the mass of the Moon is 7.3×10^{22} kg; the mass of the Sun is 1.99×10^{30} kg.

Diameter of Influenza virus is ~20 nm.

Typical airport runway length is 3.35 km; Boeing 767 jet is 64 m long.

The diameter of a CD or a DVD is 12 cm; the diameter of the center hole is 15 mm.