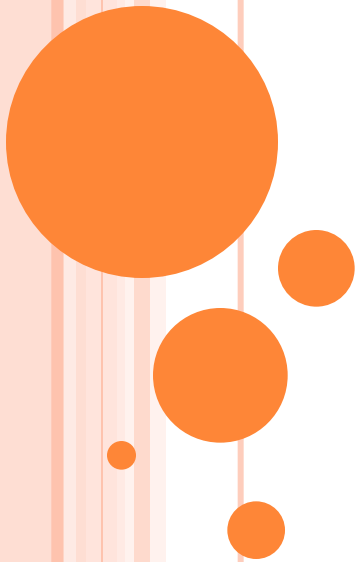


ATOMS ARE REALLY SMALL!!

- We can't work with individual atoms in the LAB
- Because we can't see things that small

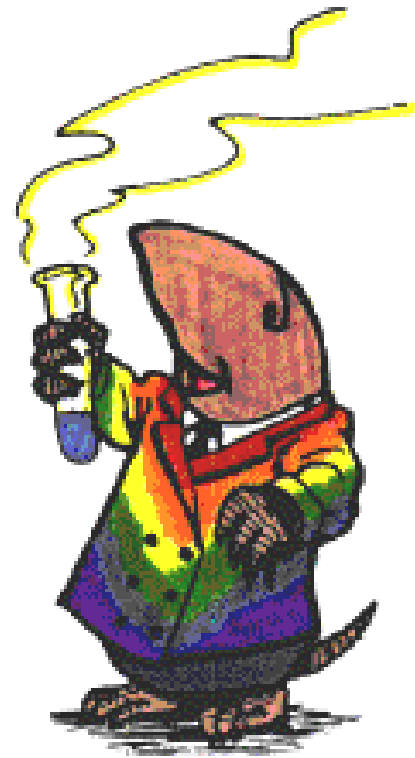


**SO LET'S COUNT A
WHOLE BUNCH
ALL AT ONCE!**



A NEW UNIT OF MEASUREMENT THE MOLE

6.02 x 10²³

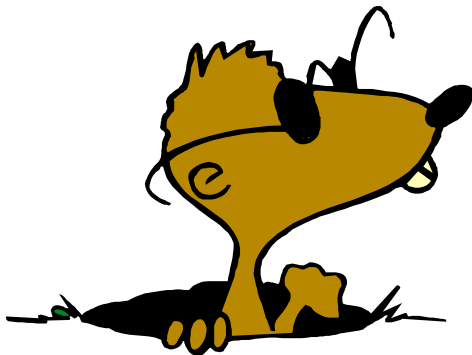


THE MOLE

- A counting unit

- Similar to a dozen, except instead of 12, it's 602 billion trillion

602,000,000,000,000,000,000,000,000,000,000



AVOGADRO'S NUMBER

o **Amedeo Avogadro**

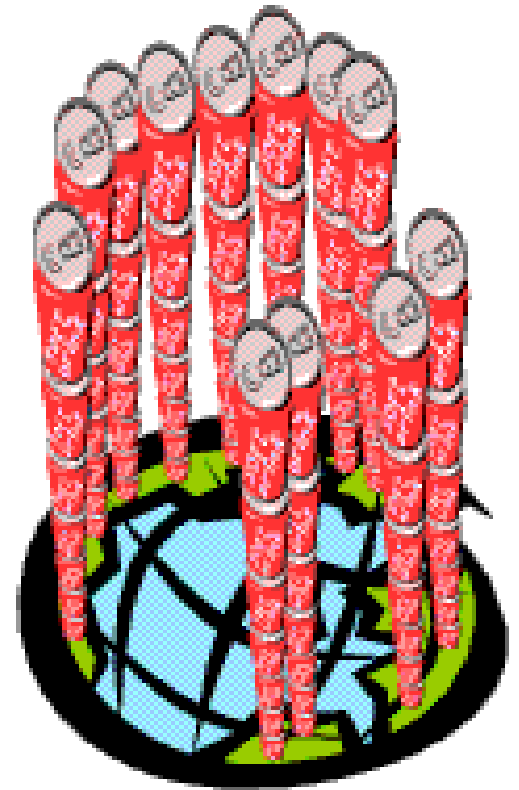
1776 – 1856

- o **The number of atoms in 1 mole**
- o **6.02×10^{23} molecules per mole**



JUST HOW BIG IS A MOLE?

- Soda cans to cover the surface of the earth over 200 miles deep.
- Avogadro's number of unpopped popcorn kernels spread across the USA...over 9 miles deep.
- Count atoms at the rate of 10 million per second, it would take about 2 billion years to count the atoms in one mole.



A MOLE OF PARTICLES

CONTAINS 6.02×10^{23} PARTICLES

1 mole C = 6.02×10^{23} C atoms

1 mole H₂O = 6.02×10^{23} H₂O molecules

1 mole CaCl₂ = 6.02×10^{23} CaCl₂ compounds

6.02×10^{23} Ca²⁺ ions and

1.204×10^{24} Cl⁻ ions



THE MOLE IS A UNIT SONG

<https://www.youtube.com/watch?v=1R7NiIum2TI>



COUNTING VERSUS WEIGHING!

- 1 dozen cookies = 12 cookies
- 1 mole of cookies = 6.02×10^{23} cookies
- 1 dozen cars = 12 cars
- 1 mole of cars = 6.02×10^{23} cars
- 1 dozen Al atoms = 12 Al atoms
- 1 mole of Al atoms = 6.02×10^{23} atoms

**The NUMBER is always the same,
but the MASS is very different!**



MASS OF AN ATOM

- TINY TINY TINY!!!! - USE A SPECIAL UNIT:

Atomic mass unit = “amu”

$$1 \text{ amu} = 1.66 \times 10^{-24} \text{ grams}$$

$$1 \text{ atom of H} = 1.66 \times 10^{-24} \text{g} = 1 \text{ amu}$$

$$1 \text{ atom of C} = 1.99 \times 10^{-23} \text{g} = 12 \text{ amu}$$

$$1 \text{ atom of O} = 2.656 \times 10^{-23} \text{g} = 16 \text{ amu}$$



○ How much does a mole of something weigh???

1 mole of C atoms = 12.0 g

1 mole of Mg atoms = 24.3 g

1 mole of Cu atoms = 63.5 g

MOLAR MASS - HOW MANY GRAMS PER MOLE?

Molar Mass of C = 12.01 g/mol

Molar Mass of Mg = 24.3 g/mol

THE CONVERSION FACTOR VERSION!

Like saying 12in/ft



LEARNING CHECK!

Find the molar mass

(usually we round to the tenths place)

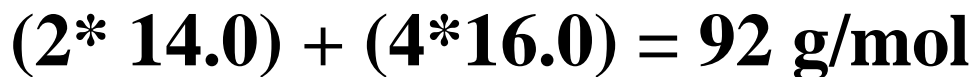
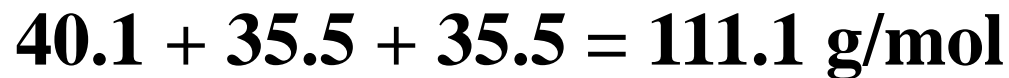
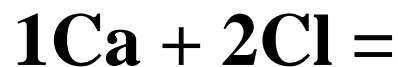
$$1) \text{ Br} = 79.9 \text{ g/mole}$$

$$2) \text{ Sn} = 118.7 \text{ g/mole}$$



MOLAR MASS OF MOLECULES & COMPOUNDS

Add up the mass for each part of the molecule



LEARNING CHECK!

A. Molar Mass of $K_2O = ?$ Grams/mole



$$K = 39.1 \text{ g/mol} \quad O = 16 \text{ g/mol}$$

$$(2 * 39.1 \text{ g/mol}) + (1 * 16.0 \text{ g/mol}) = 94.2 \text{ g/mol}$$

B. Molar Mass of antacid $Al(OH)_3 = ?$



$$Al = 27.0 \text{ g/mol} \quad O = 16 \text{ g/mol} \quad H = 1.0 \text{ g/mol}$$

$$(1 * 27.0 \text{ g/mol}) + (3 * 16.0 \text{ g/mol}) + (3 * 1.0) = 78 \text{ g/mol}$$

