

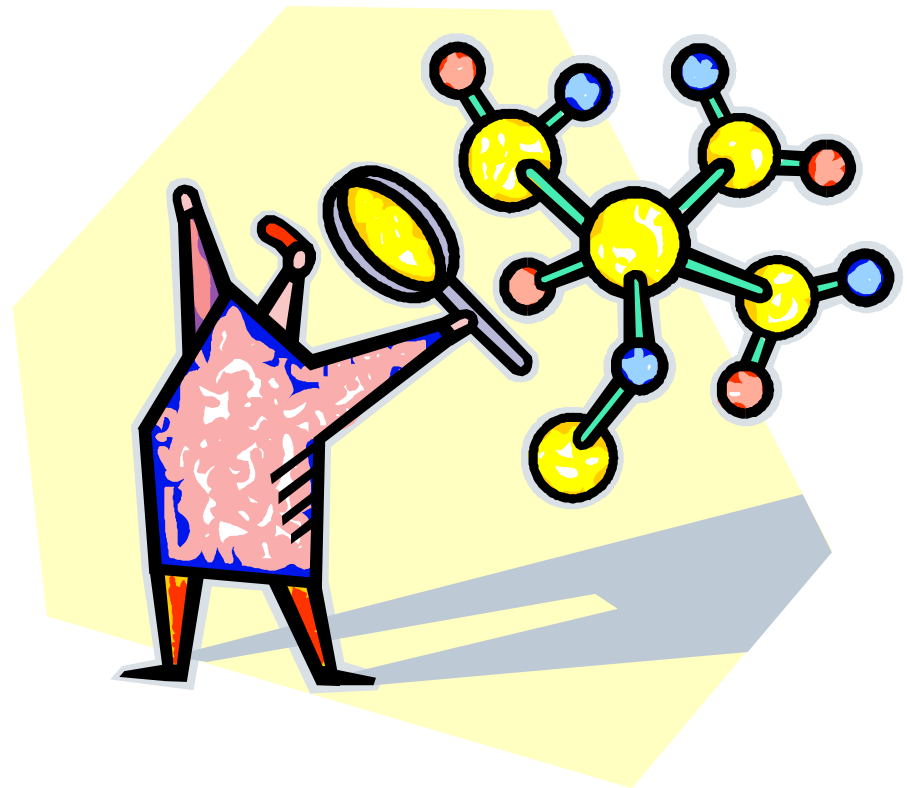
**THE “MOLE”**

**AND**

**“MOLAR MASS”**

# 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

**$6.02 \times 10^{23}$**

- A counting unit
- Like a “dozen” but really, really big!



# The Mole

Don't need to write down  
what's in the orange boxes

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

**602,000,000,000,000,000,000,000**



# Avogadro's Number

Amedeo Avogadro 1776 – 1856

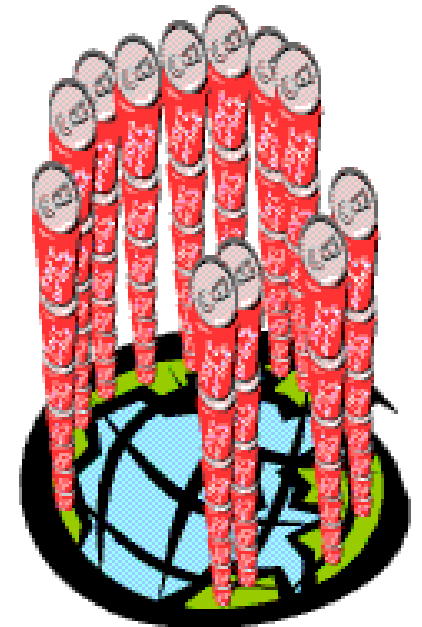
Decided that:

$6.02 \times 10^{23}$   
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”

Particles is a generic term

**ATOMS** → 1 mole C

**MOLECULES** → 1 mole H<sub>2</sub>O

**COMPOUNDS** → 1 mole CaCl<sub>2</sub>

**IONS** → NH<sub>4</sub><sup>+</sup>

1 mole H<sub>2</sub>O

1 mole molecules

2 moles H atoms

1 mole O atoms



# The Mole is a Unit Song

<https://www.youtube.com/watch?v=1R7Nilum2TI>

# COUNTING VERSUS WEIGHING!

- 1 dozen donuts = 12 donuts
- 1 mole of donuts =  $6.02 \times 10^{23}$  donuts
- 1 dozen Al atoms = 12 Al atoms
- 1 mole of Al atoms =  $6.02 \times 10^{23}$  atoms

**The NUMBER in a mole 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”**

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

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

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

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

# Molar Mass How many GRAMS PER MOLE?

**LOOK ON THE PERIODIC TABLE!**

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

**THE CONVERSION FACTOR VERSION!**

Molar Mass of C = 12.01 g/mol

Molar Mass of Mg = 24.3 g/mol

Like saying 12in/ft

# Learning Check!

Find the molar mass

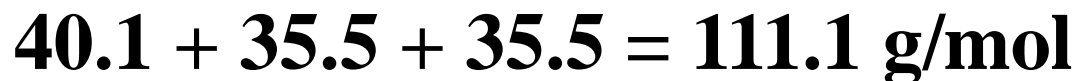
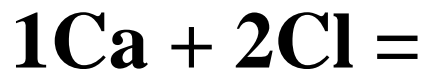
$$1) \text{ Br} = 79.9 \text{ g/mole}$$

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

*We usually round  
to one or two  
decimal places  
no big deal!*

# **Molar Mass of Molecules & compounds**

**Add up the mass for each part of the molecule**



# **Molar Mass of Molecules & compounds**

**Molar Mass of  $\text{N}_2\text{O}_4 = ?$**

**$\text{N} = 14.0 \text{ g/mol}$     $\text{O} = 16.0 \text{ g/mol}$**

**$2\text{N} + 4\text{O} =$**

**$(2 * 14.0) + (4 * 16.0) = 92 \text{ g/mol}$**

# **Molar Mass of Molecules & compounds**

**Molar Mass of antacid  $\text{Al}(\text{OH})_3 = ?$**



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

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