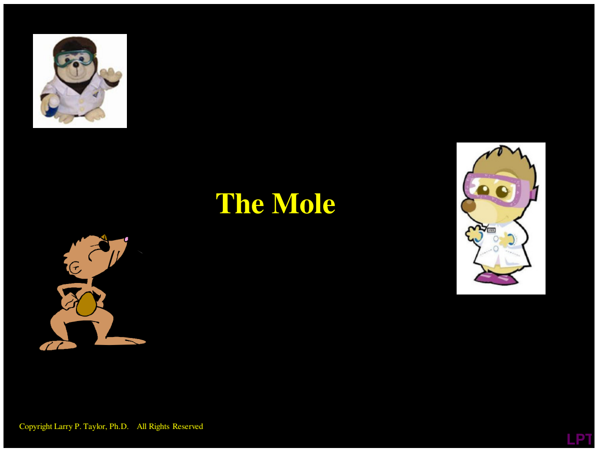
The Mole
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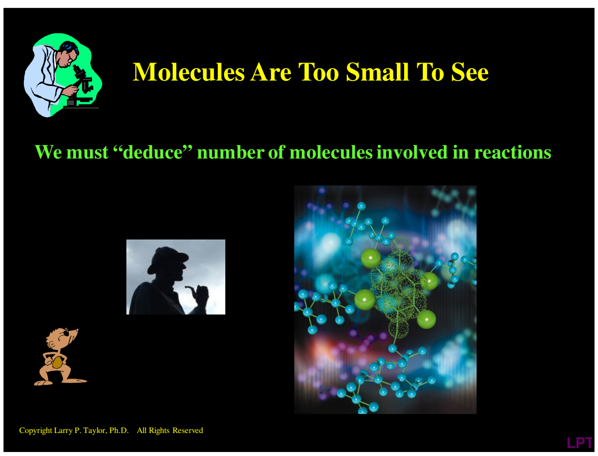
Molecules Are Too Small To See
We must "deduce" number of molecules involved in reactions
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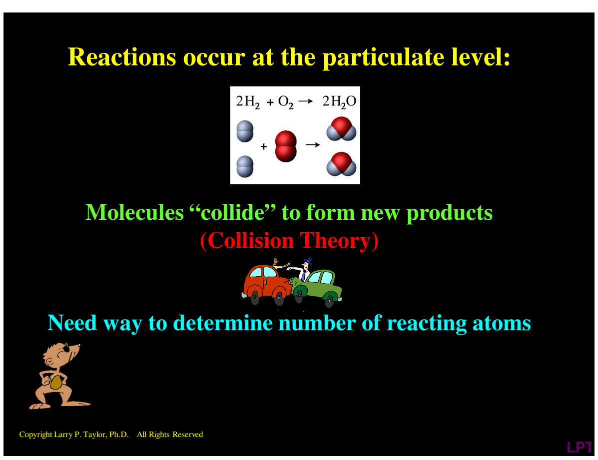
Reactions occur at the particulate level:
$2H_2 + O_2 \rightarrow 2H_2O$
Molecules "collide" to form new products
(Collision Theory)
Need way to determine number of reacting atoms
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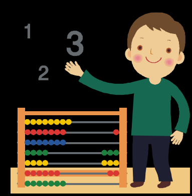
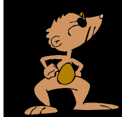
The Mole is a Chemist's Way of Counting Atoms & Molecules



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The Mole

Mole always contains the same number of formula units:
6.02×10^{23} (*Avogadro's Number*)

1 mol element = 6.02×10^{23} atoms
1 mol diatomic element = 6.02×10^{23} molecules
1 mol molecular compound = 6.02×10^{23} molecules
1 mol ionic compound = 6.02×10^{23} formula units

So, the "per" expressions:
1 mol = 6.02×10^{23} atoms
1 mol = 6.02×10^{23} molecules
1 mol = 6.02×10^{23} formula units

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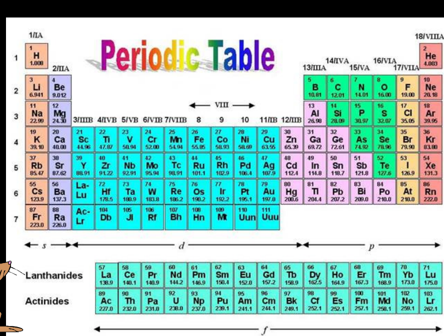
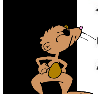
Each Element Has A Different Atomic Mass





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Each Element or Compound Mole Has Different Mass

12.01 g C
1.008 g H = Avogadro's number of atoms or molecules
2.016 g H_2
32.00 g O_2
18.02 g H_2O
58.44 g NaCl
159.7 g Fe_2O_3
108.0 g N_2O_5
~68,000 g Hemoglobin

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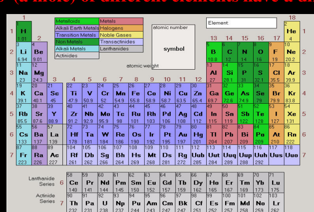
The Mole

A Mole always contains same number of particulates (formula units)

But

Since each element /compound has a different mass,

Equal # atoms (a mole) of different elements have a different mass



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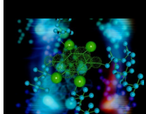
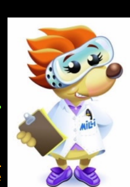
Mole Map



Avagadro's
$\frac{6.02 \times 10^{23}\ \text{fu}}{\text{mole}}$



Molar Mass
g / mole

Atomic Units — Moles — Grams

Avogadro's Number: From Memory
Molar Mass: Calculated from Periodic Table
Let the Units Drive the Solution!

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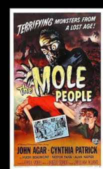
Let's Study the Mole, People



The Mole Lab

Today's Lab

Work In Pairs

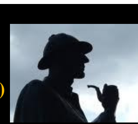
See Video on The Mole

Identify Unknown Elements

Determine Moles and Formula Units for Ionic Compounds

Determine Moles and Molecules for Molecular Compound

Element Identification

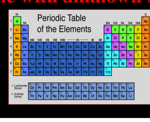


Select 3 Element Vials (with different colored dots)
- Each vial marked with:
  - Label (Letter of the Unknown)
  - Weight of empty vial and cap

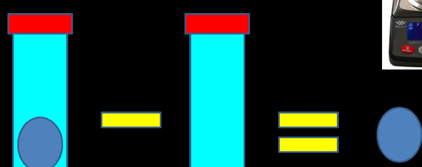
Weigh each vial
- Mass of unknown vial – mass written on vial = mass unknown

Determine Atomic Mass of the unknown (grams / mole)
- mass (grams) unknown / 0.100 mole = unknown atomic mass

Identify Unknown Element
- Find element on the periodic table with unknown's atomic mass



Weighing By Difference



Container Plus Sample Weight − Container Weight = Sample Weight

Technique gives best weight of sample
(no mechanical loss while weighing)

Moles and Formula Units

Weigh each vial
- Mass of sample vial – mass written on vial = mass sample

Determine moles of the sample (grams / mole)

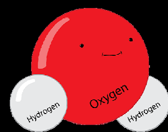
$$\text{mass (grams)} \times \frac{1 \text{ mole}}{\text{formula mass (g)}} = \text{\# Moles}$$

Identify Number of Formula Units

$$\text{\# moles} \times \frac{6.02 \times 10^{23} \text{ formula units}}{\text{mole}} = \text{\# Formula Units}$$

Each group determines both NaCl and KNO_3

Moles and Number of molecules



Measure mass of 40.0 mL of deionized water

Tare balance with 50 mL grad cylinder; fill to 40.0 mL

Measure mass

Determine moles of the sample (grams / mole)

$$\text{mass (grams)} \times \frac{1 \text{ mole}}{\text{molecular mass (g)}} = \text{\# Moles sample}$$

Identify Number of Formula Units (Molecules)

$$\text{\# moles} \times \frac{6.02 \times 10^{23} \text{ molecules}}{\text{mole}} = \text{\# Molecules in sample}$$

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Results

Fill in tables with calculated values

Conclusion

Questions

Proper units and sig figs

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Let's Boldly Go Explore Today's Lab

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