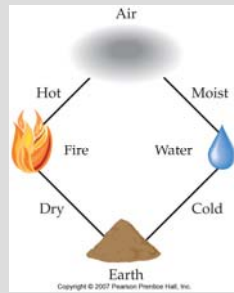


Atoms: The Greek Idea

~384 B.C.E., Aristotle: All matter is composed of 4 elements, and all matter is continuous, not atomistic.



Atoms: The Greek Idea

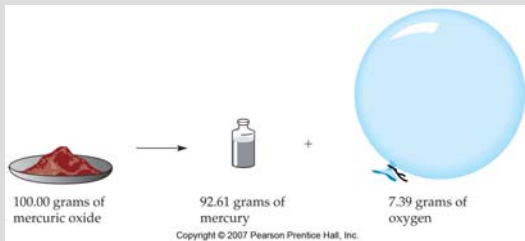
~ 450 B.C.E., **Leucippus and Democritus** Atoms: Point at which matter can no longer be subdivided.



Lavoisier: The Law of Conservation of Mass

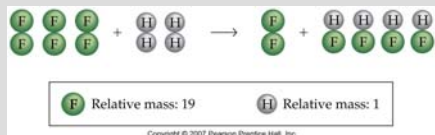
- **Early 1700's Lavoisier: Law of Conservation of Mass**
 - During a chemical change, matter is neither created nor destroyed.

Lavoisier: The Law of Conservation of Mass



Proust: The Law of Definite Proportions

- **1799, Proust: Law of Definite Proportions**
 - A compound always contains the same elements in certain definite proportions.



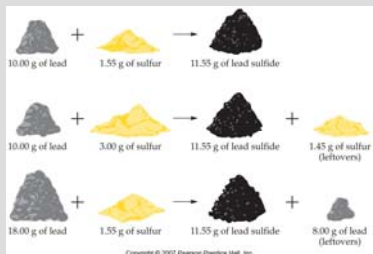
Proust: The Law of Definite Proportions

Regardless of the source, copper carbonate has the same composition.



Proust: The Law of Definite Proportions

Berzelius experiment illustrates the Law of Definite Proportions.



Atomic Theory of Matter



**JOHN
DALTON
(1766-1844)**

**“ALL MATTER
IS COMPOSED
OF SMALL
PARTICLES
CALLED ATOMS”**

Postulates of Dalton's Atomic Theory

1. All matter consists of tiny particles.

The existence of atoms was first suggested more than 2000 years before Dalton's birth. Atoms remained pure speculation through most of this time, although Newton used arguments based on atoms to explain the gas laws in 1687. (Newton's speculations about atoms in the *Principia* were carefully copied by hand into Dalton's notebooks.)



Postulates of Dalton's Atomic Theory

2. Atoms are indestructible and unchangeable.

Atoms of an element cannot be created, destroyed, broken into smaller parts or transformed into atoms of another element. Dalton based this hypothesis on the law of conservation of mass and on centuries of experimental evidence.

Postulates of Dalton's Atomic Theory


3. Elements are characterized by the mass of their atoms.

All atoms of the same element have identical weights, Dalton asserted. Atoms of different elements have different weights.

Postulates of Dalton's Atomic Theory

4. When elements react, their atoms combine in simple, whole-number ratios.

This postulate suggested a practical strategy for determining relative atomic weights from elemental percentages in compounds. Experimental atomic weights could then be used to explain the fixed mass percentages of elements in all compounds of those elements!



Was Dalton Correct?


Essentially! Atoms are divisible though...as we'll see.

Two laws are explained through these postulates...

Law of Conservation of Mass

Law of Definite Proportions

ACTIVITY TIME: GET THE CALCULATOR OUT!



Cadmium sulfide is used as a pigment in artist's oil colors. A sample of this compound is composed of 1.25 g of cadmium and 0.357 g of sulfur.

If a second sample of the same compound contains 3.50 g of sulfur, how many grams of cadmium does it contain?

Out of Chaos: The Periodic Table

- 1869, Dmitri Mendeleev
 - Mendeleev arranged the elements in order of increasing atomic mass. He left gaps for yet undiscovered elements. He predicted the properties of those elements. When those elements were eventually discovered, many of his predictions were found to be accurate.

Out of Chaos: The Periodic Table

Tabelle II.

Reihen	Gruppe I R ¹	Gruppe II R ²	Gruppe III R ³	Gruppe IV R ⁴	Gruppe V R ⁵	Gruppe VI R ⁶	Gruppe VII R ⁷	Gruppe VIII R ⁸
1	H=1							
2	Li=7	Be=9,4	B=11	C=12	N=14	O=16	F=19	
3	Na=23	Mg=24	Al=27,3	Si=28	P=31	S=32	Cl=35,5	
4	K=39	Ca=40	—=44	Ti=48	V=51	Cr=52	Mn=55	Fe=56, Co=59, Ni=59, Cu=63.
5	(Ce=63)	Zn=65	—=68	—=71	As=75	Se=78	Br=80	
6	Rb=85	Sr=87	Y=88	Zr=90	Nb=94	Mo=96	—=100	Ru=104, Rh=104, Pd=106, Ag=108.
7	(Ae=108)	Cd=112	In=113	Sn=118	Sb=122	Te=125	J=127	
8	Cs=133	Ba=137	Hf=138	Ta=140	—	—	—	
9	(—)	—	—	—	—	—	—	
10	—	—	Er=178	La=180	Ta=182	W=184	—	Os=195, Ir=197, Pt=196, Au=198.
11	(An=199)	Hg=200	Tl=204	Pb=207	Bi=208	—	—	
12	—	—	Tl=211	—	—	U=240	—	

der chemischen Elemente.

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Out of Chaos: The Periodic Table

Property	Predicted by Mendeleev for Eka-Silikon (1871)	Observed by Winkler for Germanium (1886)
Atomic mass	72	72.6
Density (g/cm ³)	5.5	5.47
Color	Dirty gray	Grayish white
Density of oxide (g/cm ³)	EsO ₂ : 4.7	GeO ₂ : 4.703
Boiling point of chloride	EsCl ₄ : below 100 °C	GeCl ₄ : 86 °C
Density of chloride (g/cm ³)	EsCl ₄ : 1.9	GeCl ₄ : 1.887

*Gallium was discovered in 1875 by P. E. Lecoq de Boisbaudran, who named it for his native land, Gaul (France). Swedish chemist Lars F. Nilson discovered scandium in 1879 and named it for Scandinavia. Finally, in 1886 C. A. Winkler discovered germanium and named it for his country, Germany.

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Atoms: Real and Relevant

Atoms are a very real concept. It is even possible to observe computer-enhanced images of atoms.

Leucippus Revisited: Molecules

Molecules are groups of atoms chemically bonded together.

A molecule of water is composed of two atoms of hydrogen (H) bonded to an atom of oxygen (O).