



Science in Action Textbook ( pgs. 112-133 )  
**Unit 2 Matter and Chemical Change**

**2.0 An understanding of the nature of matter has developed through observations over time.**

**2.1 Evolving Theories of Matter (pgs. 113-120) - Timeline**

Year	Evolving Theory of Matter	3D Model
8000 B.C.	<i>(Stone Age) Matter was made up of solid material, which could be fashioned into tools.</i>	Stone implements
6000-1000 B.C.	<i>Chemists investigated the properties of only those materials that were of high value to humans. (gold and copper)</i>	Metals
4500 B.C	<i>(Bronze Age) The effect of heat on copper, lead to the creation of a strong material (bronze) for use as tools.</i>	Bronze tools
1200 B.C.	<i>(Iron Age) Iron combined with carbon to make steel, for even stronger tools.</i>	Steel
350 B.C.	<i>Everything was made out of Air – Water - Earth – Fire (atomos particles)</i>	Earth/Wind/Fire/Ice
1500	<i>Theory of Matter was based more on experimentation. (History of Alchemy)</i>	States of Matter
1660	<i>Particles can be compressed. (Boyle)</i>	Particles
1770	<i>System for the naming of chemicals was developed. (Lavoisier)</i>	Molecule
1780	<i>Air is necessary for combustion to occur.</i>	Molecules
1808	<i>Observation principles during experimentation.</i>	Dalton Model
1897	<i>Raisin bun model with charged particles.</i>	Raisin bun
1904	<i>Negatively charged particles orbiting around nucleus.</i>	Rutherford
1922	<i>Electrons rotate randomly around the nucleus.</i>	Bohr






Today the 'quantum model' describes the atom as a cloud of electrons around a nucleus

## 2.2 Organizing the Elements (p. 122-125)







Finding a pattern in an unknown helps scientists to organize ideas and information. It also helps scientists to interpret what the information means and explain these ideas, based on what they have learned.

### Looking for Patterns

Early chemists used **symbols** of the sun and the planets to identify the metallic elements known to them.

Metal	gold	silver	iron	mercury	tin	copper	lead
Symbol							
Celestial Body	Sun	Moon	Mars	Mercury	Jupiter	Venus	Saturn

This later became a problem, when more elements were discovered, because they ran out of planets. (**History of Chemical Symbols**). **John Dalton** developed a new set of symbols in the early 1800's to improve communication between chemists.

Symbol						
Element	hydrogen	oxygen	carbon	gold	silver	mercury

**Berzelius** later revised **Dalton's** symbols by replacing them with letters, instead of pictures. He represented the elements by their first letter (capitalized), or their first two letters (first one capitalized and the second letter was lower case).

### An Order for the Elements

Elements were listed in order of their atomic mass. **Atomic mass** is the mass of one atom of an element. It is represented in **atomic mass units (amu)**.

John Newland's "**law of octaves**" identified the pattern in which the properties of the elements seemed to repeat at regular intervals, similar to the octave scale in music. Demitri Mendeleev later revised the pattern in 1869.

### Finding a Pattern

Mendeleev collected the 63 elements known at the time and arranged them according to their properties (which he wrote on a file card). He arranged the cards into a 'solitaire-like' table. By sorting and arranging the elements in this way, Mendeleev was able to identify gaps where elements, not yet discovered, would be able to fit.

			Ti=50	Zr=90	?[2]=180
			V=51	Nb=94	Ta=182
			Cr=52	Mo=96	W=186
			Mn=55	Rh=104,4[3]	Pt=197,4[4]
			Fe=56	Ru=104,4	Ir=198
			Ni=Co=59	Pd=106,6	Os=199
H=1[5]			Cu=63,4	Ag=108	Hg=200
	Be=9,4	Mg=24	Zn=65,2	Cd=112	
	B=11	Al=27,4	?[6]=68	Ur=116[7]	Au=197?
	C=12	Si=28	?[8]=70	Sn=118	
	N=14	P=31	As=75	Sb=122	Bi=210?
	O=16	S=32	Se=79,4	Te=128?	
	F=19	Cl=35,5	Br=80	J=127[9]	
Li=7	Na=23	K=39	Rb=85,4	Cs=133	Tl=204
		Ca=40	Sr=87,6	Ba=137	Pb=207
		?[10]=45	Ce=92[11]		
		?Er=56	La=94		
		?Yt=60	Di=95		
		?In=75,6	Th=118?		

### 1.3 The Periodic Table Today ( Periodic Table Video Note Booklet )

About 112 elements are known today.

They are organized into what is called **'The Periodic Table of Elements'**

In 1875 gallium was discovered and proved that Mendeleev's organization of the elements worked, because it fit in where he had placed a (?). The next (?) was not replaced until 1939 when francium was discovered.

#### Understanding the Periodic Table ( Web Elements.com )

1																2																			
H																He																			
3		4														5		6		7		8		9		10									
Li		Be														B		C		N		O		F		Ne									
11		12														13		14		15		16		17		18									
Na		Mg														Al		Si		P		S		Cl		Ar									
19		20		21		22		23		24		25		26		27		28		29		30		31		32		33		34		35		36	
K		Ca		Sc		Ti		V		Cr		Mn		Fe		Co		Ni		Cu		Zn		Ga		Ge		As		Se		Br		Kr	
37		38		39		40		41		42		43		44		45		46		47		48		49		50		51		52		53		54	
Rb		Sr		Y		Zr		Nb		Mo		Tc		Ru		Rh		Pd		Ag		Cd		In		Sn		Sb		Te		I		Xe	
55		56		57		72		73		74		75		76		77		78		79		80		81		82		83		84		85		86	
Cs		Ba		La		Hf		Ta		W		Re		Os		Ir		Pt		Au		Hg		Tl		Pb		Bi		Po		At		Rn	
87		88		89		104		105		106		107		108		109		110																	
Fr		Ra		Ac		Rf		Db		Sg		Bh		Hs		Mt		Uun																	

58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Horizontal rows are called **periods** (numbered 1-7)

Vertical columns form a **group**, or **family** of elements (numbered 1-18)

[Different versions] <http://chemlab.pc.maricopa.edu/periodic/foldedtable.html>

Los Alamos Periodic Table

Visual Elements (Flash Version)

#### Useful Information On Each Element

Atomic Number	3	2	Ion charge
Element Symbol	Li	1	
Element Name	Lithium		
Atomic Mass	6.941		

Other Names for Elements

#### Patterns of Information In The Periodic Table

Metals, Non-metals and metalloids

Groups

Periods

#### Other Interesting Patterns

Alkali metals

Alkali-earth metals

Halogens

Noble gases

**Check and Reflect** p. 134

**Assess Your Learning** p. 136-137