

Chapter 6 : The Periodic Table and Periodic Law

Section 1 Notes

Development of the Periodic Table

Section 6-1

In the 1700s, Lavoisier compiled a list of all the known elements of the time.

Table 6.1	Lavoisier's Table of Simple Substances (Old English Names)
Gases	light, heat, dephlogisticated air, phlogisticated gas, inflammable air
Metals	antimony, silver, arsenic, bismuth, cobalt, copper, tin, iron, manganese, mercury, molybdena, nickel, gold, platina, lead, tungsten, zinc
Nonmetals	sulphur, phosphorus, pure charcoal, radical muriatique*, radical fluorique*, radical boracique*
Earths	chalk, magnesia, barote, clay, siliceous earth

* no English name

Development of the Periodic Table (cont.)

Section 6-1

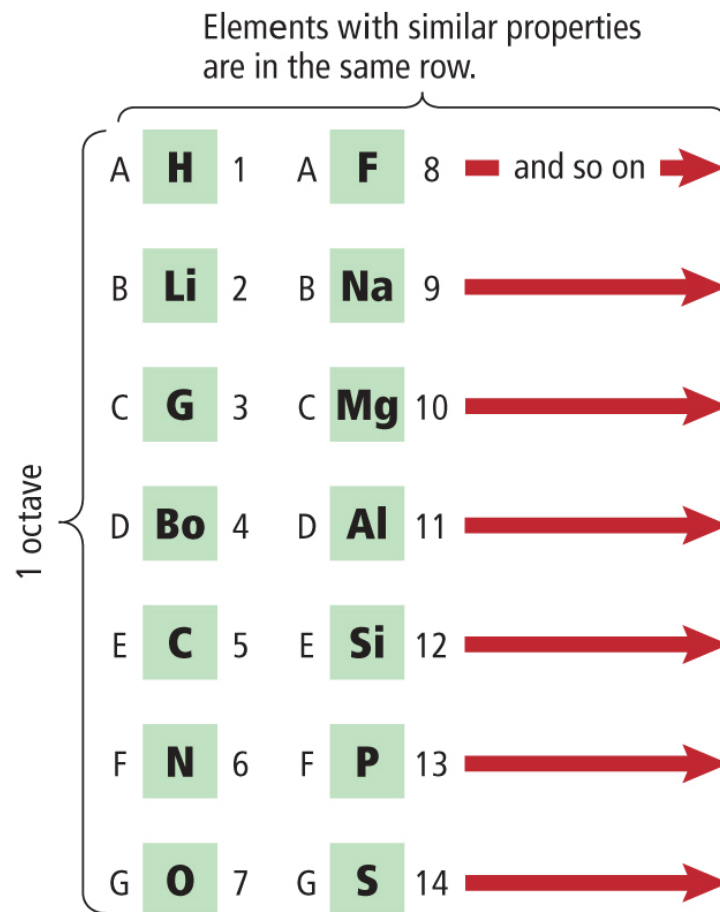
The 1800s brought large amounts of information and scientists needed a way to organize knowledge about elements.

John Newlands proposed an arrangement where elements were ordered by increasing atomic mass.

Development of the Periodic Table (cont.)

Section 6-1

Newlands noticed when the elements were arranged by increasing atomic mass, their properties repeated every eighth element.



Development of the Periodic Table (cont.)

Section 6-1

Meyer and Mendeleev both demonstrated a connection between atomic mass and elemental properties.

Moseley rearranged the table by increasing atomic number, and resulted in a clear periodic pattern.

Periodic repetition of chemical and physical properties of the elements when they are arranged by increasing atomic number is called periodic law.

Section 6-1

Table 6.2

Contributions to the Classification of Elements

John Newlands (1837–1898)

- arranged elements by increasing atomic mass
- noticed the repetition of properties every eighth element
- created the law of octaves

Lothar Meyer (1830–1895)

- demonstrated a connection between atomic mass and elemental properties
- arranged the elements in order of increasing atomic mass

Dmitri Mendeleev (1834–1907)

- demonstrated a connection between atomic mass and elemental properties
- arranged the elements in order of increasing atomic mass
- predicted the existence and properties of undiscovered elements

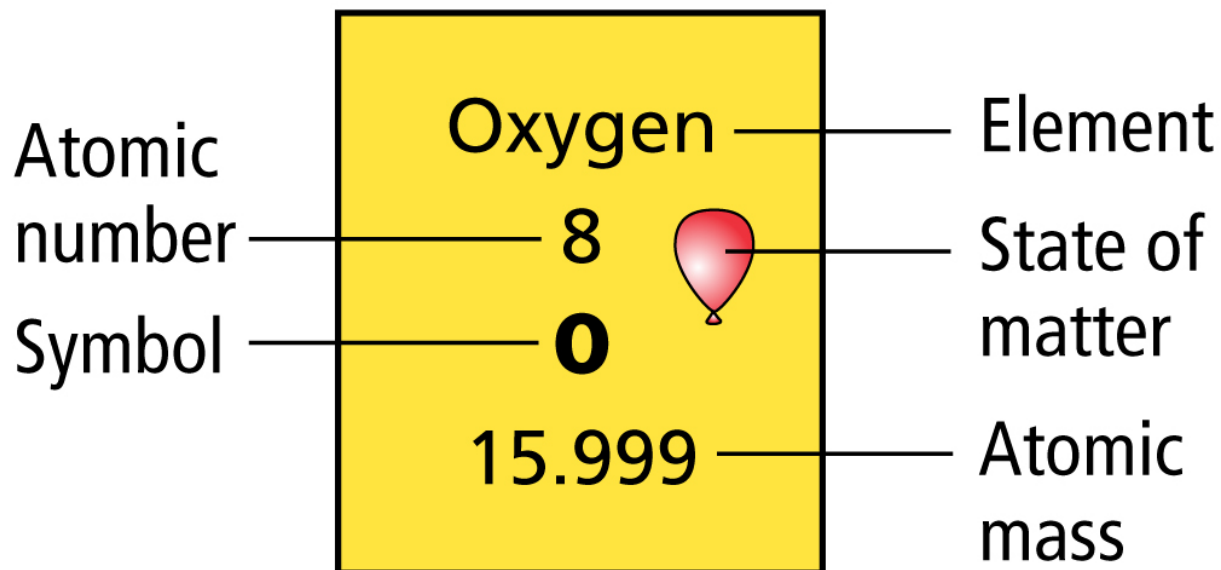
Henry Moseley (1887–1915)

- discovered that atoms contain a unique number of protons called the atomic number
- arranged elements in order of increasing atomic number, which resulted in a periodic pattern of properties

The Modern Periodic Table

Section 6-1

The modern periodic table contains boxes which contain the element's name, symbol, atomic number, and atomic mass.



The Modern Periodic Table (cont.)

Section 6-1

Columns of elements are called groups.

Rows of elements are called periods.

Elements in groups 1,2, and 13-18 possess a wide variety of chemical and physical properties and are called the representative elements.

Elements in groups 3-12 are known as the transition metals.

The Modern Periodic Table (cont.)

Section 6-1

Elements are classified as metals, non-metals, and metalloids.

Metals are elements that are generally shiny when smooth and clean, solid at room temperature, and good conductors of heat and electricity.

Alkali metals are all the elements in group 1 except hydrogen, and are very reactive.

Alkaline earth metals are in group 2, and are also highly reactive.

The Modern Periodic Table (cont.)

Section 6-1

The transition elements are divided into transition metals and inner transition metals.

The two sets of inner transition metals are called the lanthanide series and actinide series and are located at the bottom of the periodic table.

The Modern Periodic Table (cont.)

Section 6-1

Non-metals are elements that are generally gases or brittle, dull-looking solids, and poor conductors of heat and electricity.

Group 17 is composed of highly reactive elements called halogens.

Group 18 gases are extremely unreactive and commonly called noble gases.

The Modern Periodic Table (cont.)

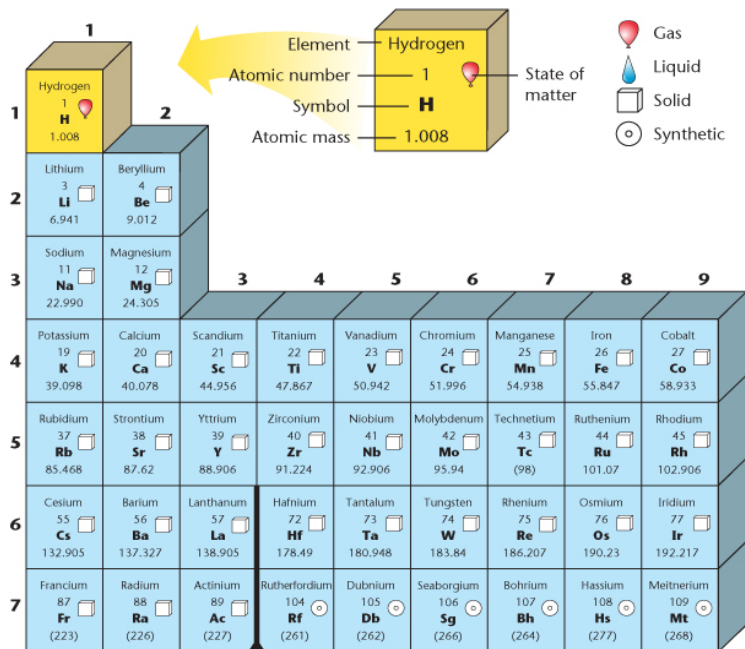
Section 6-1

Metalloids have physical and chemical properties of both metals and non-metals, such as silicon and germanium.

The Modern Periodic Table (cont.)

Section 6-1

PERIODIC TABLE OF THE ELEMENTS

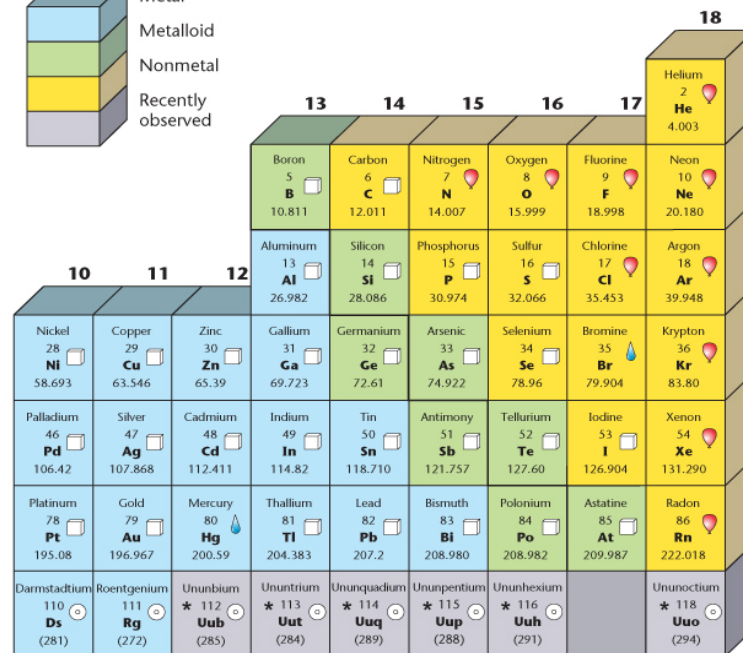
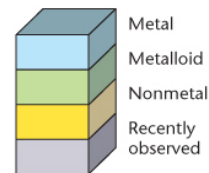


The number in parentheses is the mass number of the longest lived isotope for that element.

Lanthanide series

Actinide series

Cerium 58 Ce 140.115	Praseodymium 59 Pr 140.908	Neodymium 60 Nd 144.242	Promethium 61 Pm (145)	Samarium 62 Sm 150.36	Europium 63 Eu 151.965
Thorium 90 Th 232.038	Protactinium 91 Pa 231.036	Uranium 92 U 238.029	Neptunium 93 Np (237)	Plutonium 94 Pu (244)	Americium 95 Am (243)



* The names and symbols for elements 112, 113, 114, 115, 116, and 118 are temporary. Final names will be selected when the elements' discoveries are verified.

Gadolinium 64 Gd 157.25	Terbium 65 Tb 158.925	Dysprosium 66 Dy 162.50	Holmium 67 Ho 164.930	Erbium 68 Er 167.259	Thulium 69 Tm 168.934	Ytterbium 70 Yb 173.04	Lutetium 71 Lu 174.967
Curium 96 Cm (247)	Berkelium 97 Bk (247)	Californium 98 Cf (251)	Einsteinium 99 Es (252)	Fermium 100 Fm (257)	Mendelevium 101 Md (258)	Nobelium 102 No (259)	Lawrencium 103 Lr (262)

CONCEPTS In MOTION

Click here to view an animated version of this graphic.

Organizing the Elements by Electron Configuration

Section 6-2

Recall electrons in the highest principal energy level are called valence electrons.

All group 1 elements have one valence electron.

Table 6.3	Electron Configuration for the Group 1 Elements		
Period 1	hydrogen	$1s^1$	$1s^1$
Period 2	lithium	$1s^22s^1$	$[\text{He}]2s^1$
Period 3	sodium	$1s^22s^22p^63s^1$	$[\text{Ne}]3s^1$
Period 4	potassium	$1s^22s^22p^63s^23p^64s^1$	$[\text{Ar}]4s^1$

Organizing the Elements by Electron Configuration (cont.)

Section 6-2

The energy level of an element's valence electrons indicates the period on the periodic table in which it is found.

The number of valence electrons for elements in groups 13-18 is ten less than their group number.

Organizing the Elements by Electron Configuration (cont.)

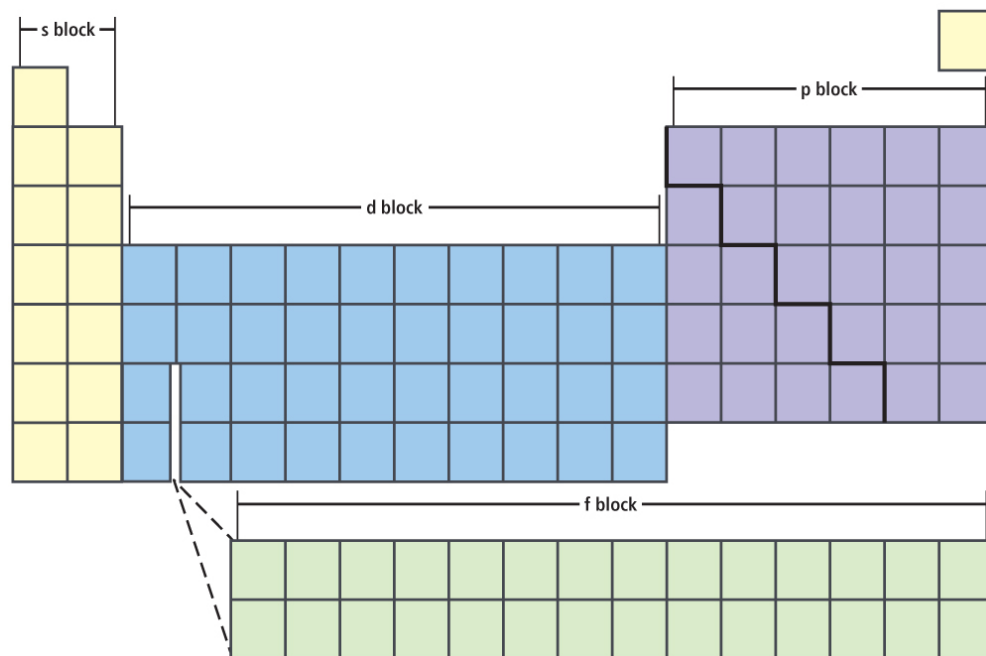
Section 6-2

	1								18
1	H·								He:
2	Li·	Be·		.B·	.C·	.N·	.O·	:F·	:Ne:
3	Na·	Mg·		.Al·	.Si·	.P·	.S·	:Cl·	:Ar:
4	K·	Ca·		.Ga·	.Ge·	.As·	.Se·	:Br·	:Kr:
5	Rb·	Sr·		.In·	.Sn·	.Sb·	.Te·	:I·	:Xe:
6	Cs·	Ba·		.Tl·	.Pb·	.Bi·	.Po·		:Rn:

The s-, p-, d-, and f-Block Elements

Section 6-2

The shape of the periodic table becomes clear if it is divided into blocks representing the atom's energy sublevel being filled with valence electrons.



The s-, p-, d-, and f-Block Elements (cont.)

Section 6-2

s-block elements consist of group 1 and 2, and the element helium.

Group 1 elements have a partially filled s orbital with one electron.

Group 2 elements have a completely filled s orbital with two electrons.

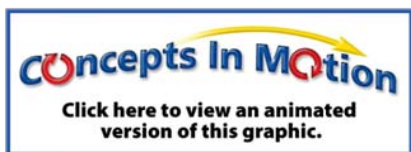
The s-, p-, d-, and f-Block Elements (cont.)

Section 6-2

After the s-orbital is filled, valence electrons occupy the p-orbital.

Groups 13-18 contain elements with completely or partially filled p orbitals.

Table 6.4		Noble Gas Electron Configuration	
Period	Principal Energy Level	Element	Electron Configuration
1	$n = 1$	helium	$1s^2$
2	$n = 2$	neon	$[\text{He}]2s^22p^6$
3	$n = 3$	argon	$[\text{Ne}]3s^23p^6$
4	$n = 4$	krypton	$[\text{Ar}]4s^24p^6$



The s-, p-, d-, and f-Block Elements (cont.)

Section 6-2

The d-block contains the transition metals and is the largest block.

There are exceptions, but d-block elements usually have filled outermost s orbital, and filled or partially filled d orbital.

The five d orbitals can hold 10 electrons, so the d-block spans ten groups on the periodic table.

The s-, p-, d-, and f-Block Elements (cont.)

Section 6-2

The f-block contains the inner transition metals.

f-block elements have filled or partially filled outermost s orbitals and filled or partially filled 4f and 5f orbitals.

The 7 f orbitals hold 14 electrons, and the inner transition metals span 14 groups.