TOPIC

- Terminology of the periodic table
- Introduction of group characteristics

Periodic Table

Old Periodic Law
- Dmitri Mendeleev developed the modern periodic table. Argued that element properties are periodic functions of their atomic weights.

New Periodic Law
- Properties of elements are periodic functions of their ATOMIC NUMBERS.
  
  • See CD-ROM, Screen 2.16.

Periods in the Periodic Table

<table>
<thead>
<tr>
<th>Periods</th>
<th>1s</th>
<th>2s</th>
<th>2p</th>
<th>3s</th>
<th>3p</th>
<th>4s</th>
<th>3d</th>
<th>4p</th>
<th>5s</th>
<th>4d</th>
<th>5p</th>
<th>6s</th>
<th>4f</th>
<th>6p</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>H</td>
<td>He</td>
<td>Li</td>
<td>Be</td>
<td>B</td>
<td>C</td>
<td>N</td>
<td>O</td>
<td>F</td>
<td>Ne</td>
<td>Na</td>
<td>Mg</td>
<td>Al</td>
<td>Si</td>
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<tr>
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<td>Mg</td>
<td>Al</td>
<td>Si</td>
<td>P</td>
<td>S</td>
<td>Cl</td>
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<td>Ca</td>
<td>Sc</td>
<td>Ti</td>
<td>V</td>
<td>Cr</td>
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<td>Mn</td>
<td>Fe</td>
<td>Co</td>
<td>Ni</td>
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<td>Zn</td>
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<td>Ge</td>
<td>As</td>
<td>Se</td>
<td>Br</td>
<td>Kr</td>
<td>Rb</td>
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<tr>
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<td>Zr</td>
<td>Nb</td>
<td>Mo</td>
<td>Tc</td>
<td>Ru</td>
<td>Rh</td>
<td>Pd</td>
<td>Ag</td>
<td>Cd</td>
<td>In</td>
<td>Sn</td>
<td>Sb</td>
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<tr>
<td></td>
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<td>I</td>
<td>Xe</td>
<td>Cs</td>
<td>Ba</td>
<td>La</td>
<td>Ce</td>
<td>Pr</td>
<td>Nd</td>
<td>Pm</td>
<td>Sm</td>
<td>Eu</td>
<td>Gd</td>
<td>Tb</td>
</tr>
</tbody>
</table>

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Group 1A: Alkali Metals

- They are all metals except for Hydrogen
- They are all solids at room temperature except for Hydrogen – a diatomic gas
- They are very reactive
  - They react with water to form $H_2$ & alkaline solution
  - They are found in nature as compounds e.g NaCl
  - They combine with oxygen to form oxides $A_2O$, $Li_2O$, $Na_2O$, $K_2O$, $Rb_2O$, $Cs_2O$.
- Na & K compounds are important in human & plant diets
Group 2A: Alkaline Earth Metals

- They are all metals
- They are very reactive
  - They occur only as compounds in nature e.g. limestone – CaCO3, Ca is found in bones
  - They react with water to produce alkaline solutions (except, Be)
  - They form oxides of the form AO with oxygen (e.g. lime CaO, MgO)

- Their oxides react with water to form alkaline solution
- Radium (Ra), the heaviest member is radioactive It is used for cancer treatment

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Group 3A: B, Al, Ga, In, Tl

- Al, Ga, In, & Tl are metals. B is a metalloid
- They combine with oxygen to form oxides with general formula $X_2O_3$ e.g. $Al_2O_3$
- Al is the most abundant metal in the earth crust at 8.2%
- B is found in Borax used as antiseptic, cleaning agent and flux

Group 4A: C, Si, Ge, Sn, Pb

- Quartz, $SiO_2$
- Diamond
Group 4A: C, Si, Ge, Sn, Pb

C – Non-metal
Si, Ge – Metalloids
Sn, Pb – Metals

Chemistry in the group varies because of the change from non-metal to metal - e.g. although they form oxide of the kind XO₂
CO₂ is a colorless gas
SiO₂ (sand, quartz) is a solid

Group 4A: C, Si, Ge, Sn, Pb

C – basis for all organic compounds
Si, Ge – used in semiconductors,
Sn – used in alloys. E.g. Bronze is an alloy of Sn & Cu
Pb – Previously used in paints, & pipes.
They are toxic

4A: C, Si, Ge, Sn, Pb

Carbon exist in different forms called Allotropes
- Graphite (used in combination with clay to form pencils)
- Diamond (Hard, used for drilling)
- Amorphous (soot, buckminsterfullerenes or “buckyballs”)
Group 5A: N, P, As, Sb, Bi

- **N, P** – Non-metals
- **As, Sb** - Metalloids
- **Bi** - Metal

N exist naturally in the form N₂, constitute 75% of atmosphere and does not react easily.

P has several allotropes, white & red P are common.
- White P is very reactive. It ignites in air. It is stored under water.

Bi is not radioactive but all elements with masses greater than bismuth (83) are radioactive (i.e., they emit α, β, or γ rays).
Group 5A: N, P, As, Sb, Bi

They form oxygen or sulfur containing compound
With general formula $E_2O_3$ or $E_2S_3$

Group 6A: O, S, Se, Te, Po

Shuttle main engines use $H_2$ and $O_2$

Sulfur

Group 6A: O, S, Se, Te, Po

O, S, Se – Non-metals
Te – Metalloid
Po – Metal (Radioactive)
S, Se, Te - Chalcogens

$O_2$ – constitute 20% of atmosphere
$O_3$ – Ozone is an allotrope of O
S – Yellow powder. Has many allotropes
Po – is radioactive
Group 7A: F, Cl, Br, I, At

All members are non metals
Members together are called Halogens
All exist as diatomic molecules – F₂, Cl₂, Br₂, I₂
They react violently with Group1A metals to form Salts e.g. NaCl
They also combine with many other metals to form salts

Group 8A: He, Ne, Ar, Kr, Xe, Rn

- Lighter than air balloons
- “Neon” signs

XeOF₄
He, Ne, Ar, Kr, Xe, Rn

All are non-metals. All are gases
They are very reluctant to react and are called: Noble gases or inert gases
They are the least reactive set of elements on the periodic table
They occur in low abundance in nature. Therefore They are also called Rare gases

Transition Elements

Lanthanides and actinides
Iron in air gives iron(III) oxide

Transition Elements

They are all metals
Most occur in nature in combination with other Elements. Pt, Ag, & Au are less reactive
### Transition Elements

Virtually all members have a commercial use

<table>
<thead>
<tr>
<th>Category</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural materials</td>
<td>Fe, Ti, Cr, Cu</td>
</tr>
<tr>
<td>Paints</td>
<td>Ti, Cr</td>
</tr>
<tr>
<td>Catalytic Converters</td>
<td>Pt, &amp; Rh</td>
</tr>
<tr>
<td>Coins</td>
<td>Cu, Ni, Zn</td>
</tr>
<tr>
<td>Batteries</td>
<td>Mn, Ni, Cd, Hg</td>
</tr>
</tbody>
</table>

### Transition Elements

- **Lanthanides** – First row of the bottom table
  - La (57) to Hf (72)

- **Actinides** – Second row of the bottom table
  - Ac (89) and Re(104)

- U is used as a fuel in power plants
- Am is used in smoke detectors