- So far we have talked about...

- **Synthesis Reactions:**
  - $2Mg + O_2 \longrightarrow 2MgO$
- **Decomposition Reactions:**

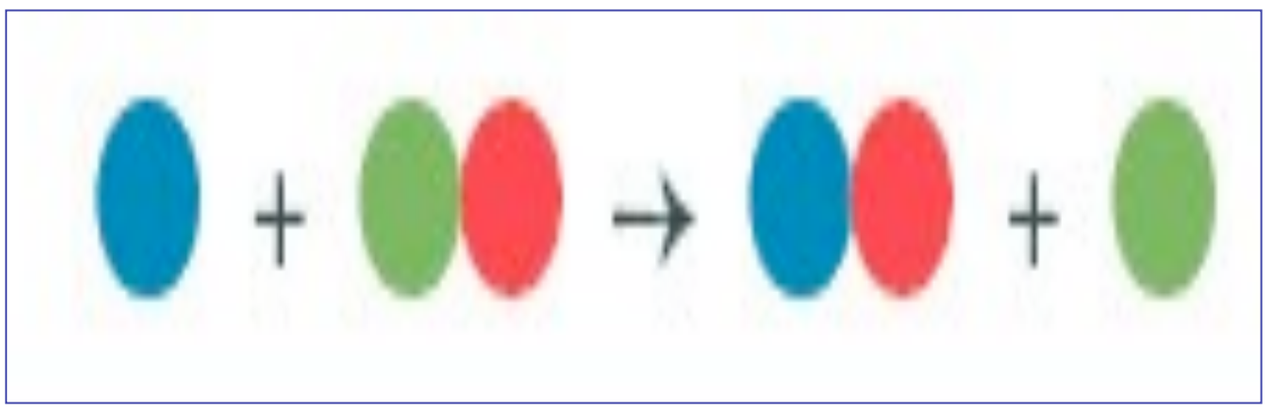
A TNT Explosion

$2C_7H_5N_3O_6\,(s) \longrightarrow 3N_2(g) + 5H_2O(g) + 7CO(g) + 7C(s)$

- **Combustion Reactions:**
  - $2C_8H_{18(g)} + 25O_{2(g)} \longrightarrow 16CO_{2(g)} + 18H_2O_{(g)}$

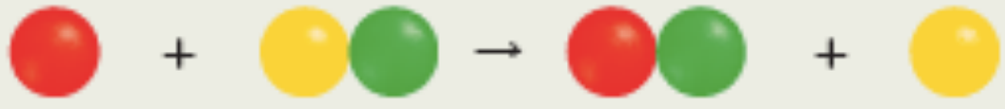
More
Chemical Reactions...

Single Displacement Reactions



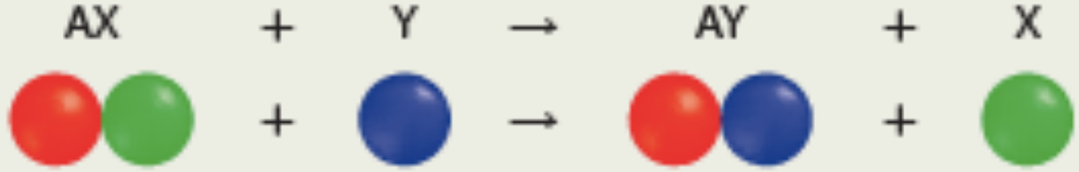
Two types

Reactions in which a metal displaces another metal:



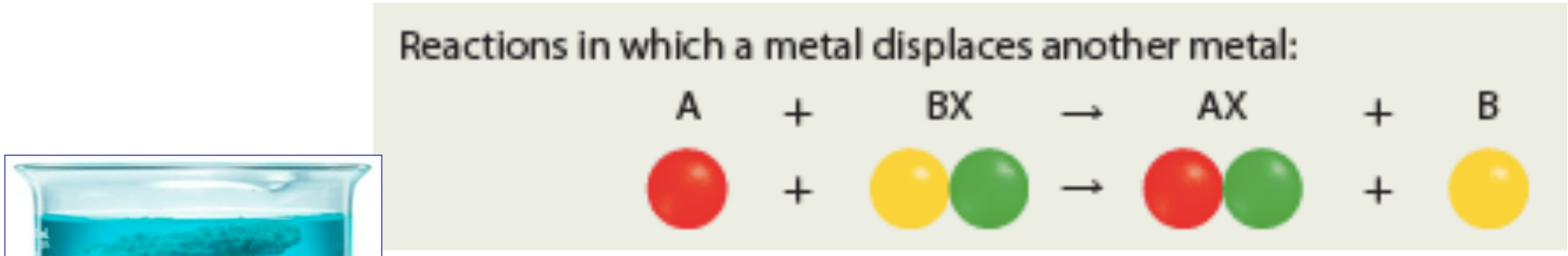
- Think: Brangelina!

Reactions in which a non-metal displaces another non-metal:



Example 1 - Displacing a Metal

- A piece of copper is placed in silver nitrate solution. A solution of copper (II) nitrate is formed, as well as solid silver.
- $Cu(s) + 2AgNO_{3(aq)} \longrightarrow Cu(NO_3)_{2(aq)} + 2Ag(s)$



So copper can displace silver...
but can silver displace copper?

Can silver displace copper?

- NO!
- $Ag + Cu(NO_3)_2 \longrightarrow$ NO REACTION
- Silver is less reactive than copper and cannot displace copper
- How do we know this?
- **The Activity Series!**
- **Turn to p.164 in your text**

Activity Series

- A relative ranking of how reactive metals are

p. 164

Metal	Displaces Hydrogen ...	Reactivity
lithium		most reactive
potassium		
barium		
calcium		
sodium	from cold water	
magnesium		
aluminum		
zinc		
chromium		
iron		
cadmium		
cobalt		
nickel		
tin		
lead	from acids	
hydrogen		
copper		
mercury		
silver		
platinum		
gold		least reactive

Example 2
Will these occur?

$$Fe(s) + CrSO_4(aq) \rightarrow$$

- NO! Iron is below chromium in the activity series

$$Pb(s) + Sn(ClO_3)_4(aq) \rightarrow$$

- NO! Lead is below tin in the activity series

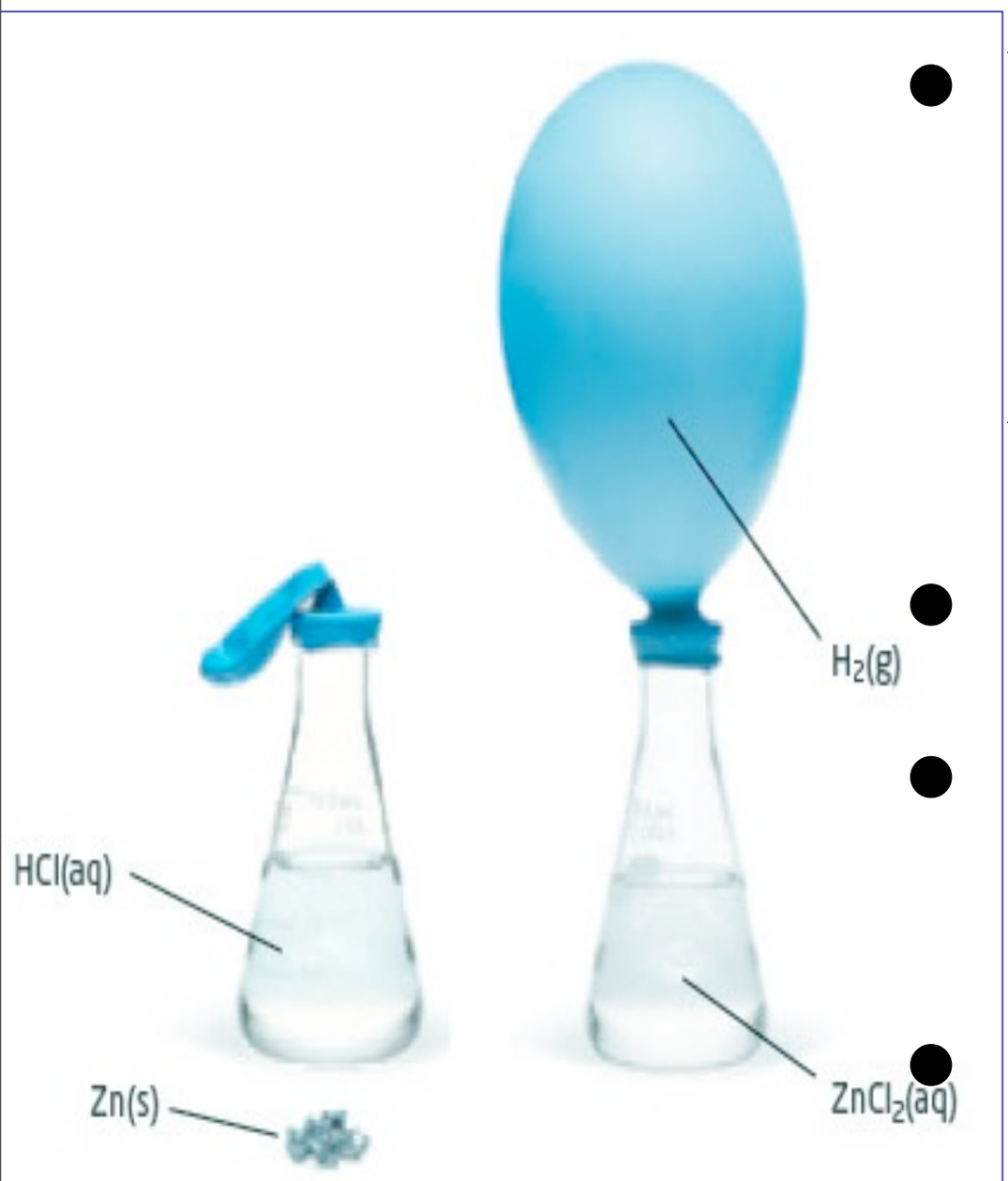
$$Na(s) + CrSO_4(aq) \rightarrow Na_2SO_{4(aq)} + Cr(s)$$

- YES!!! Sodium is ABOVE chromium

Explain!

- Write an equation and use the activity series to explain this statement.

Example 3 - Displacing hydrogen from an acid

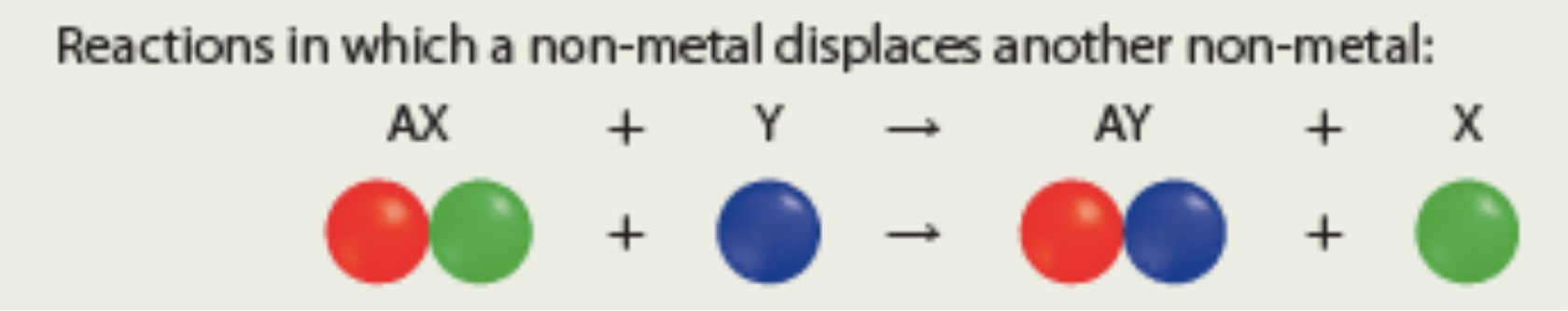


- When zinc metal is placed in hydrochloric acid, bubbles of hydrogen gas are formed, along with zinc chloride solution.
- $Zn + 2HCl_{(aq)} \rightarrow H_{2(g)} + ZnCl_{2(aq)}$
- In this case, zinc is replacing hydrogen.
- Zinc is above hydrogen in the activity series

Example 4 - Displacing hydrogen from water

- Hydrogen can also be displaced from water, but it is much harder.
- Only the most reactive metals can displace hydrogen from water
- Ie) A piece of solid sodium is placed in water. The resulting solution is sodium hydroxide with hydrogen gas being produced
- $2Na + 2H_2O \longrightarrow 2NaOH + H_2$

Non-Metal Displacement



- Non-metals have their own activity series, just like metals
- The higher the non-metal is on the periodic table, the more reactive it is

p. 168

Halogen	Reactivity
fluorine	most reactive
chlorine	
bromine	
iodine	least reactive

Will these occur?

chlorine	+	sodium bromide	
$Cl_2(g)$	+	$2NaBr(aq)$	

YES! Chlorine is more reactive than bromine and can displace it

$$Br_{2(l)} + NaI_{(aq)} \longrightarrow NaBr_{(aq)} + I_{2(l)}$$

YES! Bromine is more reactive than Iodine and can displace it

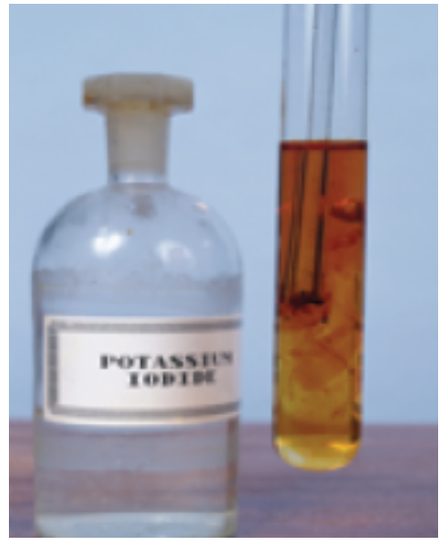
$$I_{2(s)} + NaF_{(aq)} \longrightarrow NR$$

NO! Iodine is less reactive than fluorine and can't displace it

Try it!

p. 169 #1-10

$Al_{(s)} + Ca(NO_3)_2 \longrightarrow NR$



$Cl_{2(g)} + 2KI_{(aq)} \longrightarrow 2KCl_{(aq)} + I_{2(s)}$

$Fe_{(s)} + SnSO_{4(aq)} \longrightarrow FeSO_{4(aq)} + Sn_{(s)}$

$Mg_{(s)} + HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$