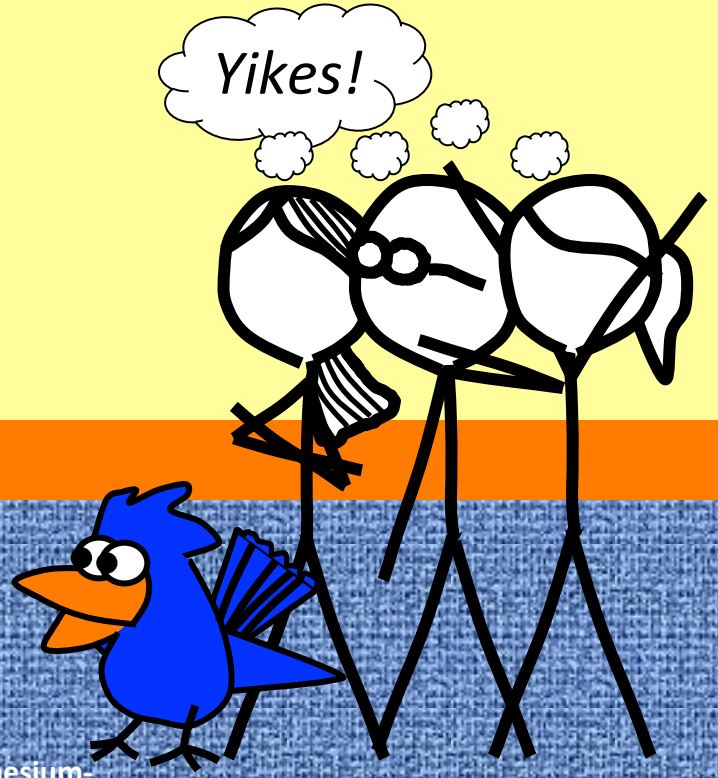
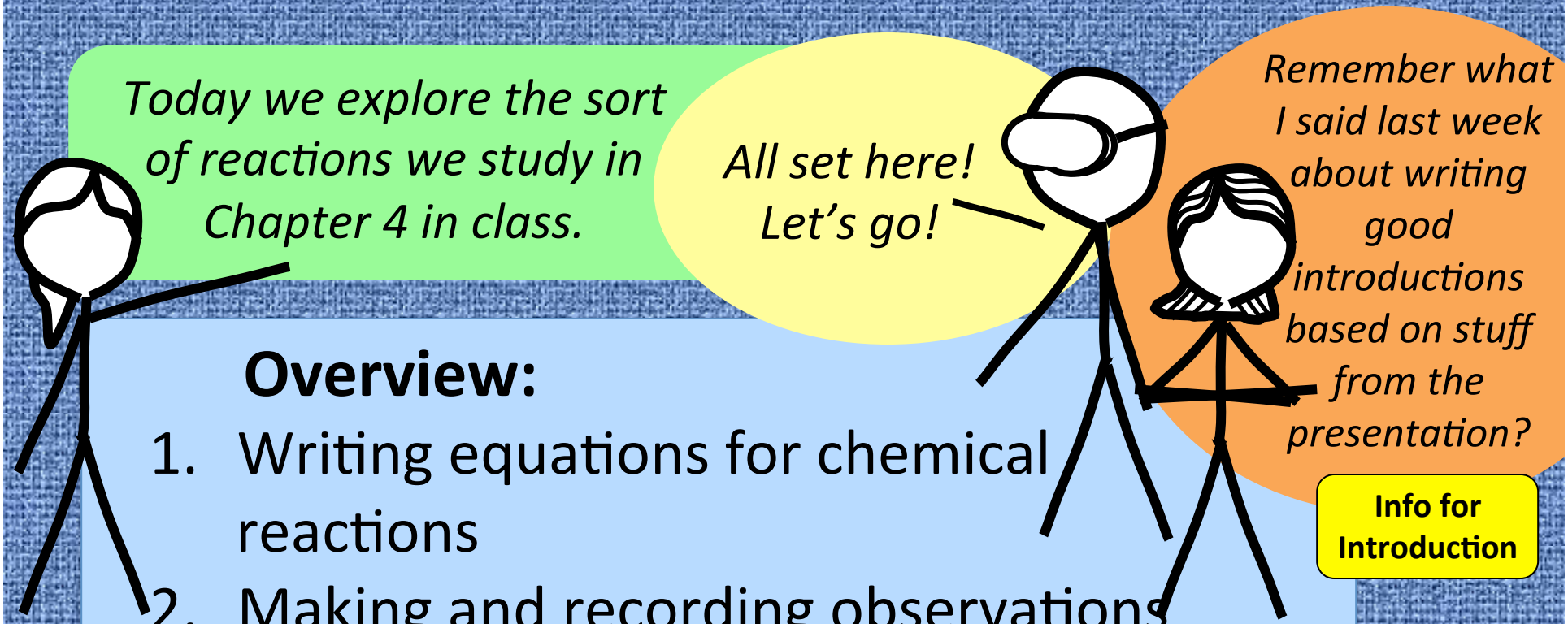
Experiment 5
24 September 2019
Classes of Chemical Reactions

http://www.gettyimages.com/detail/photo/burning-magnesium-in-oxygen-high-res-stock-photography/128545618

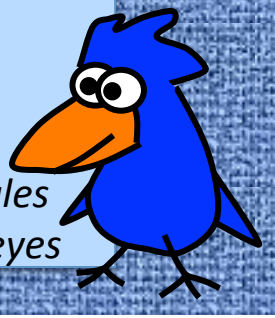


Objectives: To perform the types of reactions we are studying in Chapter 4.



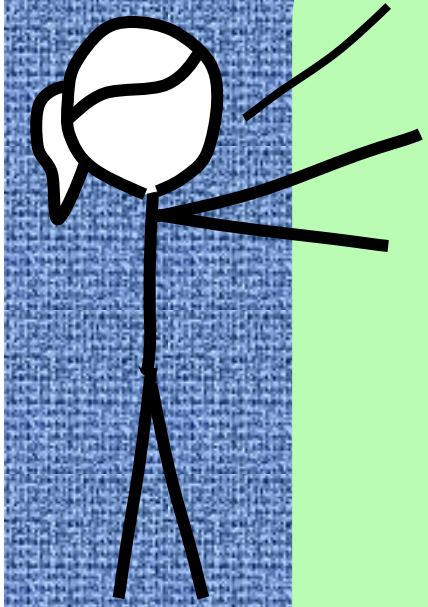
Overview:

1. Writing equations for chemical reactions
2. Making and recording observations
3. Procedure Overview
4. Summary
5. Your lab report

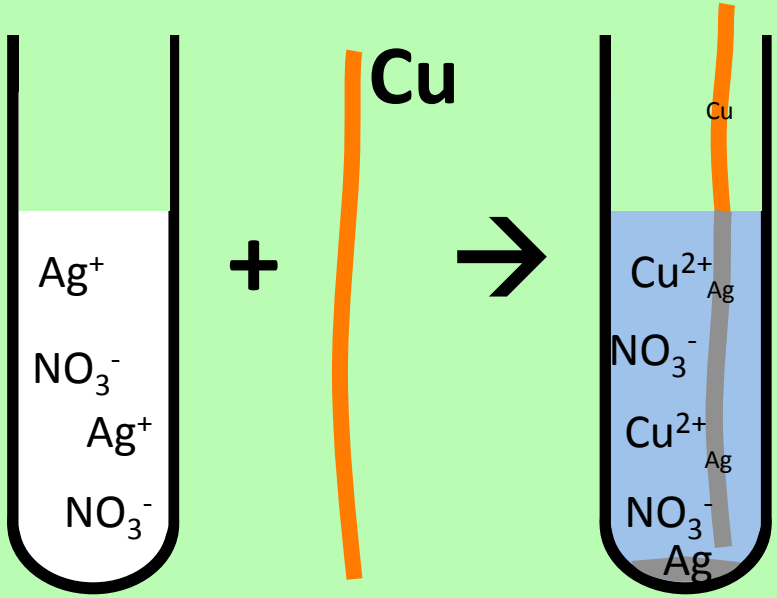


1. Writing equations for chemical reactions

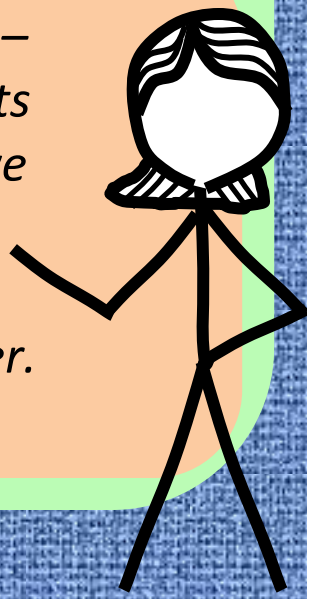
Here is a look at our first reaction today – Procedure A1, page 33. We use aqueous silver(I) nitrate and copper metal. A color change is a definite sign that a reaction took place.

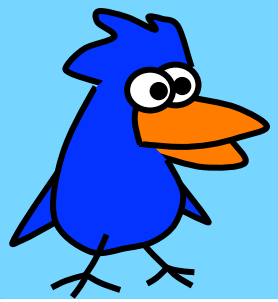


$2\ AgNO_3(aq) + Cu(s) \rightarrow\ ?$



Remember – All ionic salts that dissolve dissociate 100% into ions in water.

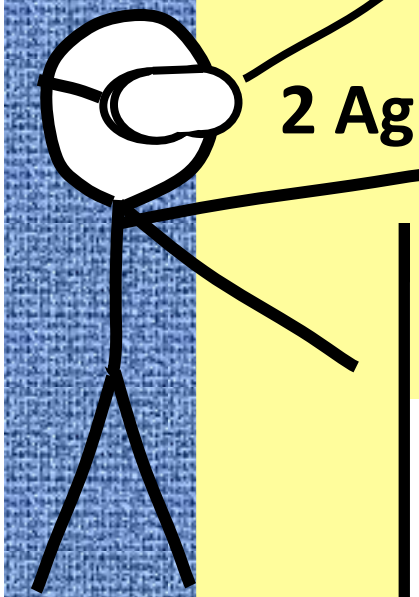




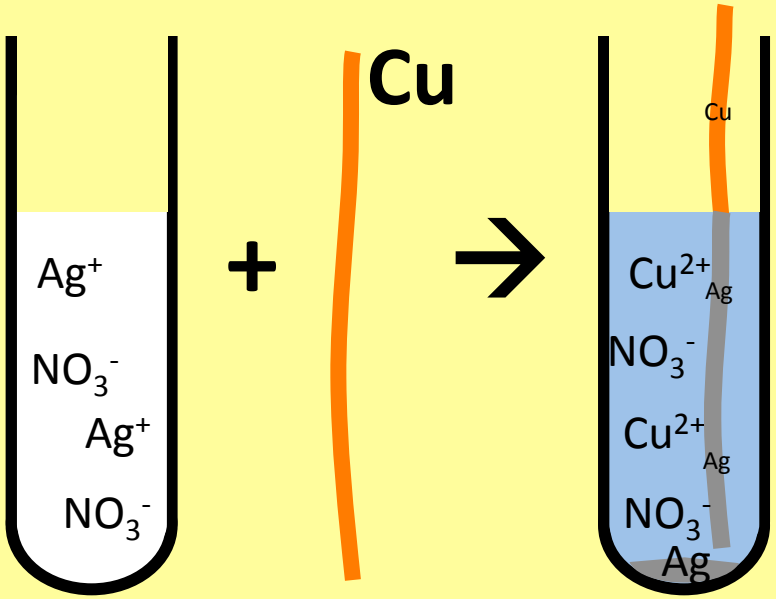
The copper wire turns gray or black – that's elemental silver and the solution turns a bit blue – a sign of Cu^{2+}... I like blue. I mean, who doesn't???

1. Writing equations for chemical reactions

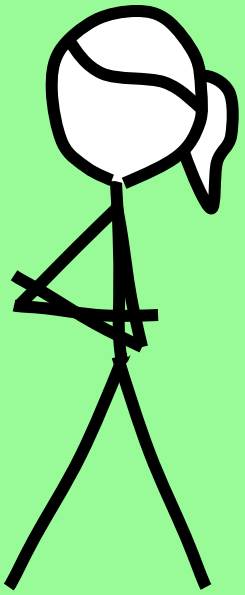
Here is the balanced equation for the reaction.



$$2\ AgNO_3(aq) + Cu(s) \rightarrow 2\ Ag(s) + Cu(NO_3)_2(aq)$$



This is a redox reaction! Silver ion was reduced and copper was oxidized. Silver ion was the oxidizing agent and…

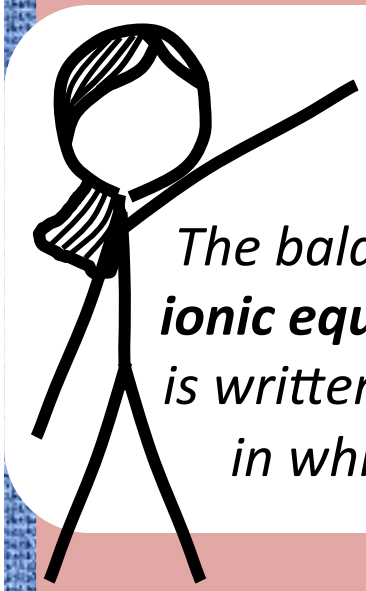


It's selfie day in lab! Send Dr M a selfie of your lab partner and you in lab doing one of today's experiments and he may post it at the Chm 204 website!

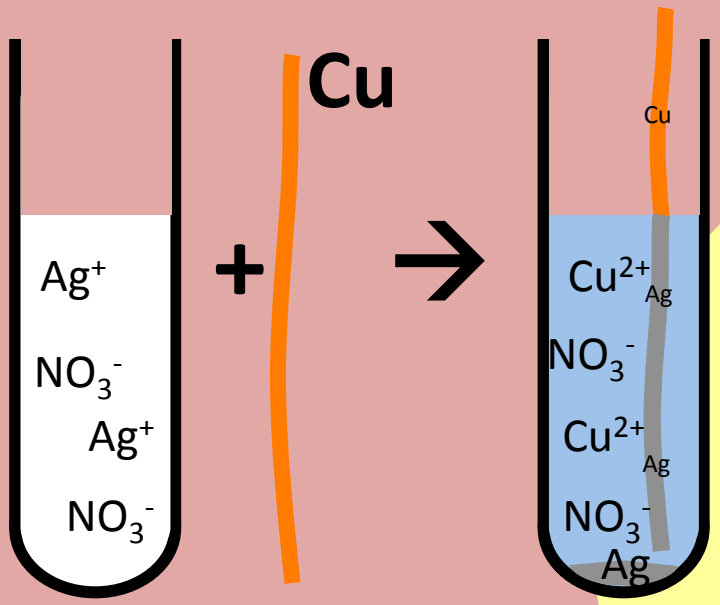
1. Writing equations for chemical reactions

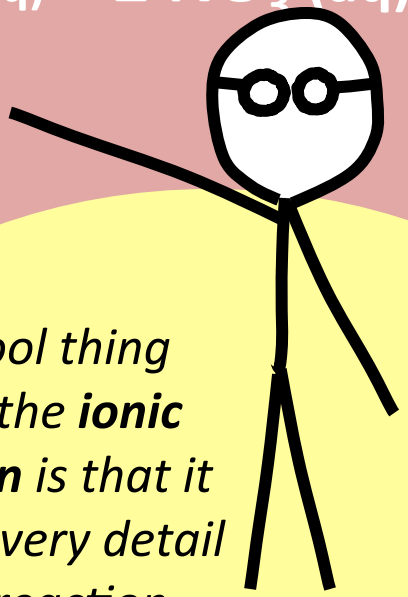
$$2\ AgNO_3(aq) + Cu(s) \rightarrow 2\ Ag(s) + Cu(NO_3)_2(aq)$$

$$2\ Ag^+(aq) + 2\ NO_3^-(aq) + Cu(s) \rightarrow 2\ Ag(s) + Cu^{2+}(aq) + 2\ NO_3^-(aq)$$

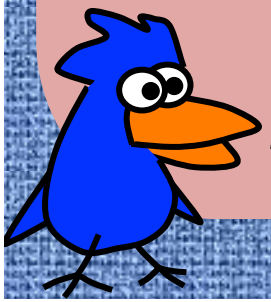


*The balanced **ionic equation** is written here in white.*





*The cool thing about the **ionic equation** is that it tells us every detail in the reaction, omitting nothing.*



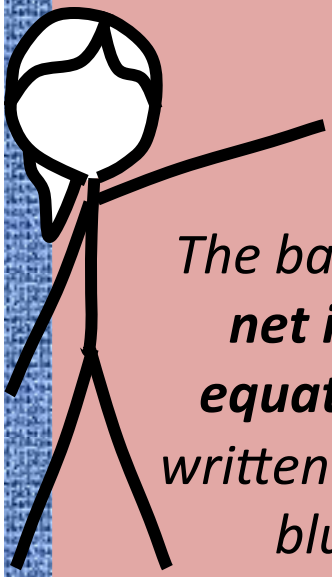
Ion charges matter.

1. Writing equations for chemical reactions

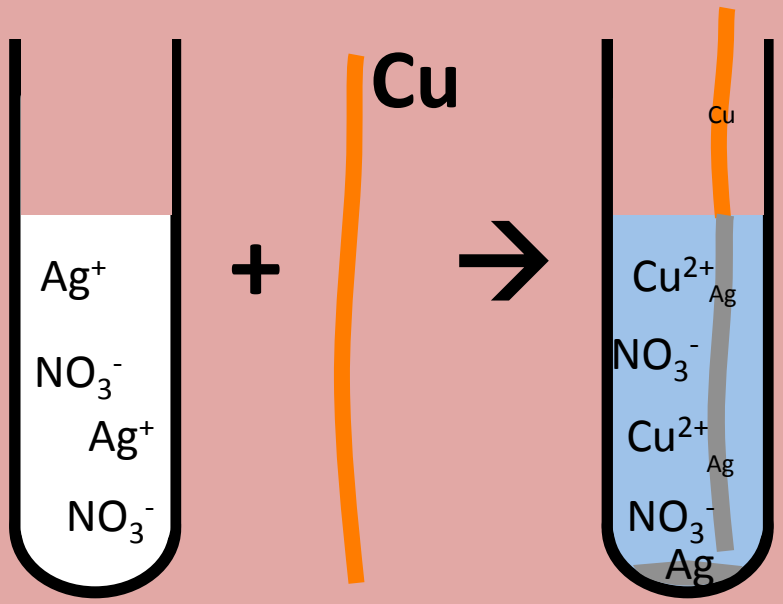
$$2\ AgNO_3(aq) + Cu(s) \rightarrow 2\ Ag(s) + Cu(NO_3)_2(aq)$$

$$2\ Ag^+(aq) + 2\ NO_3^-(aq) + Cu(s) \rightarrow 2\ Ag(s) + Cu^{2+}(aq) + 2\ NO_3^-(aq)$$

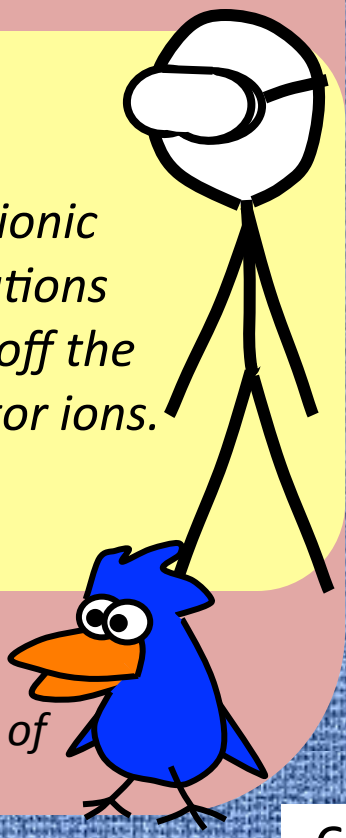
$$\mathbf{2\ Ag^+(aq) + Cu(s) \rightarrow 2\ Ag(s) + Cu^{2+}(aq)}$$



*The balanced **net ionic equation** is written here in blue.*



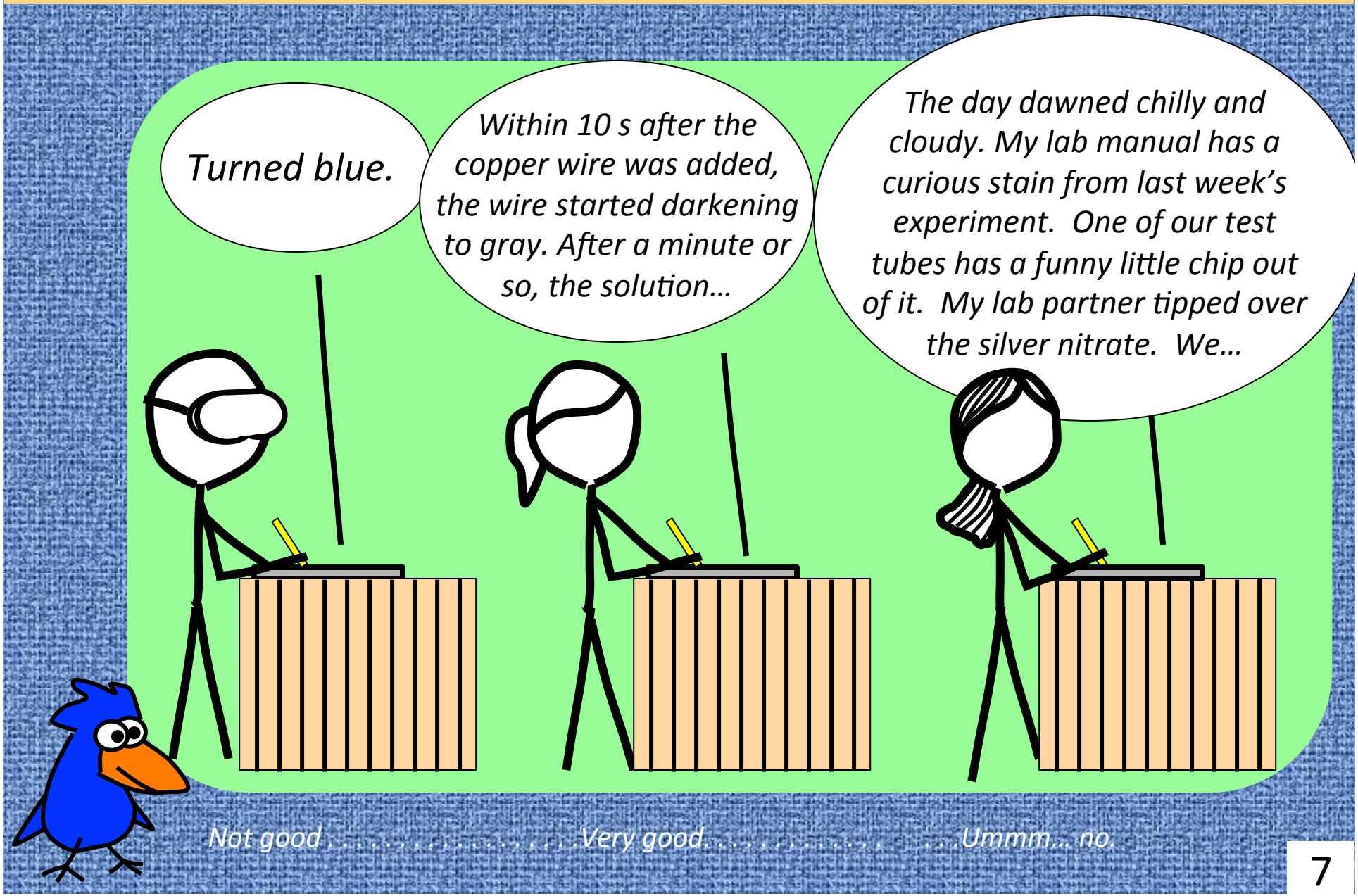
Net ionic equations leave off the spectator ions.



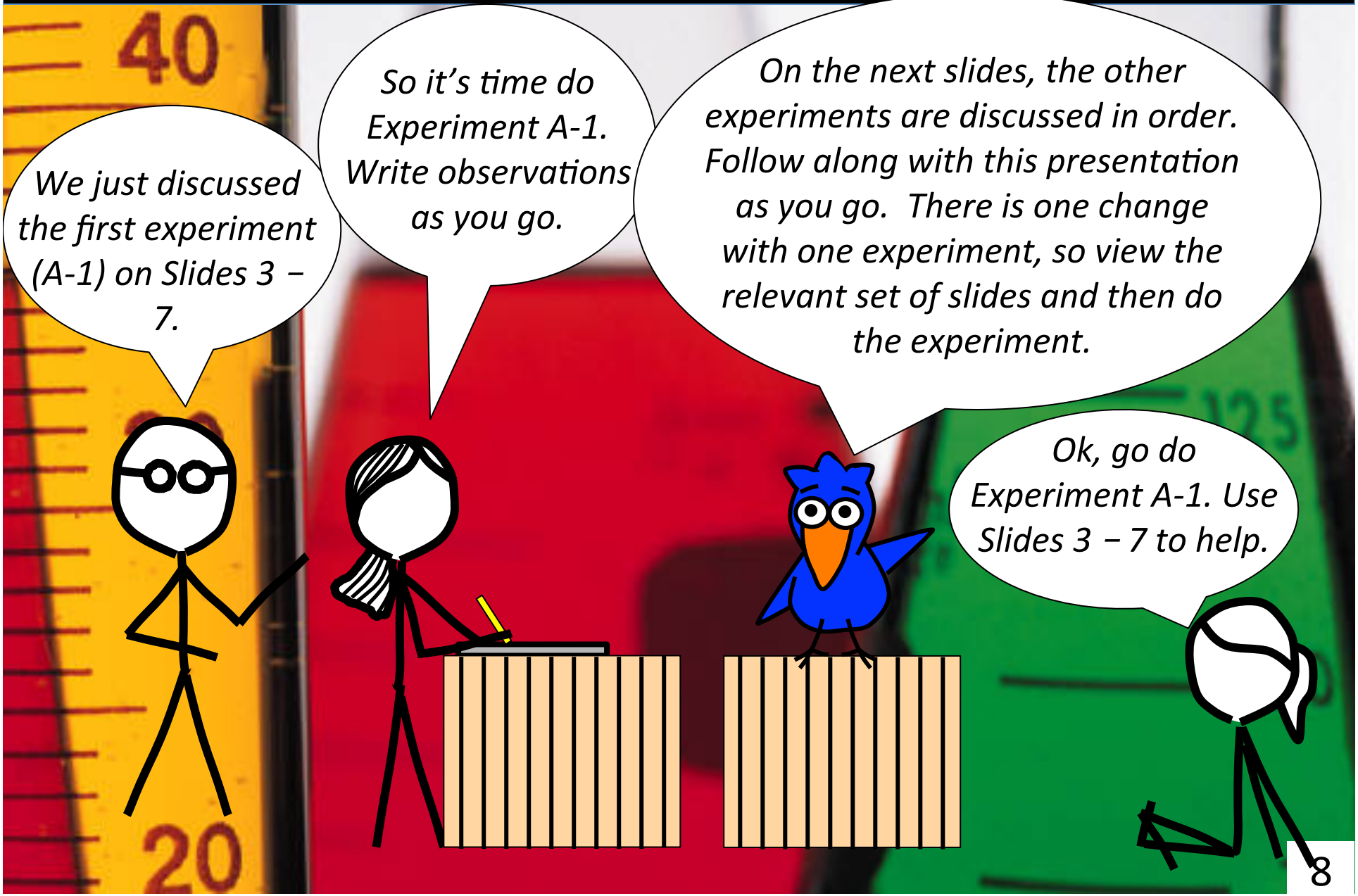
Ahhh, that distinct smell of a quiz question.

Info for Introduction

2. Making and recording observations



3. Procedure Overview



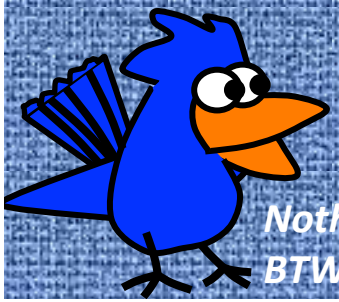
3. The reactions we will do today – Part A-2

Stuff burns. It's called combustion.

Combustion means combination with oxygen.

Hydrocarbons are compounds of hydrogen and carbon, and they all burn to produce carbon dioxide and water. Oxygen comes from the air.

We will burn methane, $CH_4(g)$ with our Bunsen burners. Methane is the main component of natural gas.



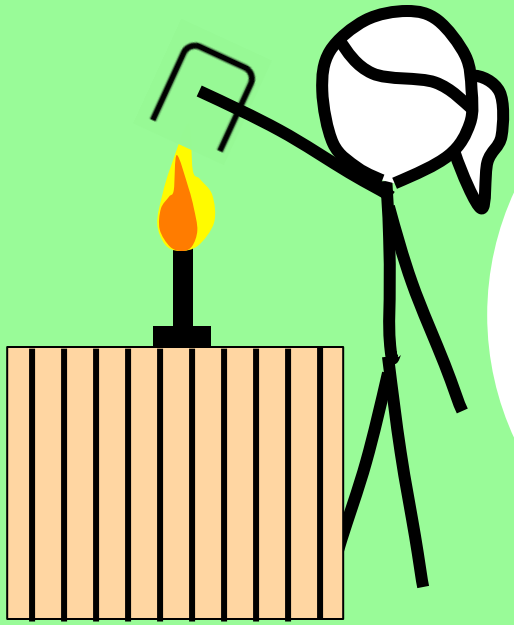
$$CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$$

Nothing is ionic so no net ionic equation.
BTW, this particular one is unbalanced.

3. The reactions we will do today – Part A2

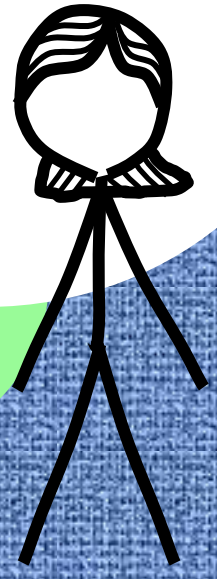
What are you doing???

Science. If I hold the beaker above the flame for a split second, it will collect carbon dioxide and water vapor.



And the water vapor condenses –

$H_2O(g) \rightarrow H_2O(l)$



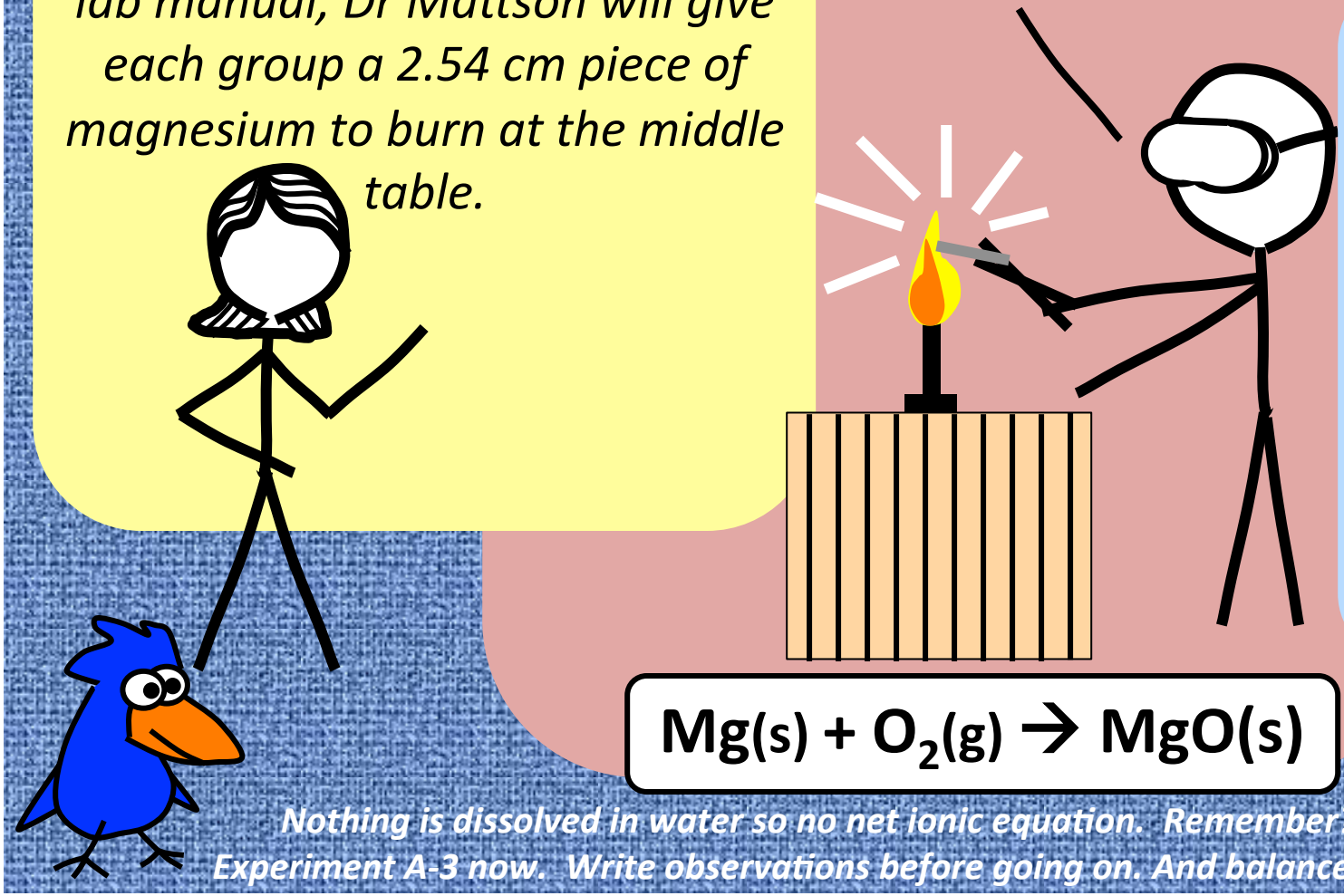
$$CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$$

Now do Experiment A-2, replete with observations.

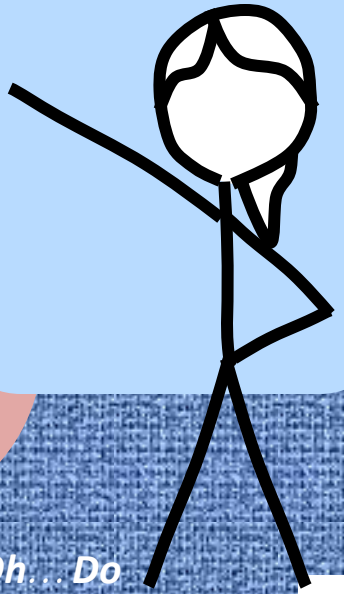
3. The reactions we will do today – Part A3

Instead of procedure A3 in the lab manual, Dr Mattson will give each group a 2.54 cm piece of magnesium to burn at the middle table.

Oooo. Bright. Bright light!



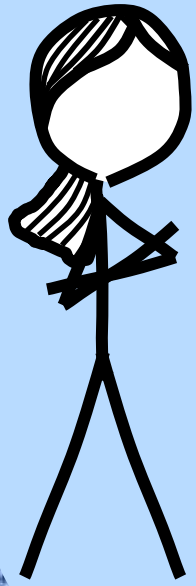
*When the MgO(s) **ash** is cool, put it to a clean beaker and save it for Part C2.*



$Mg(s) + O_2(g) \rightarrow MgO(s)$

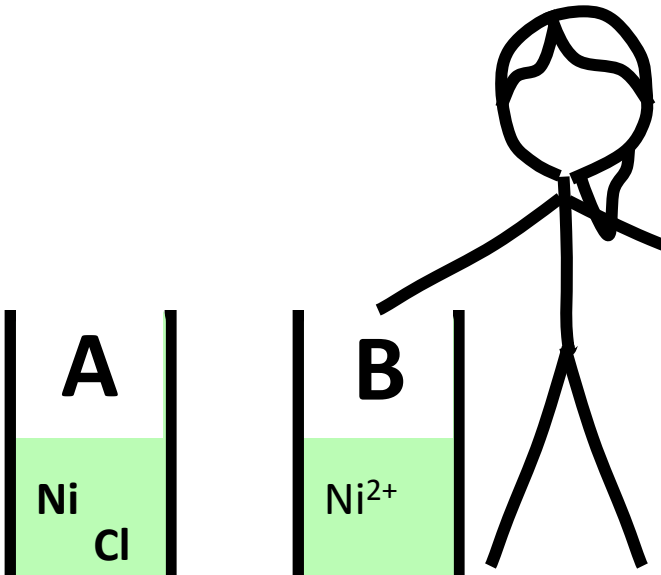
Nothing is dissolved in water so no net ionic equation. Remember? Oh… Do Experiment A-3 now. Write observations before going on. And balance the equation

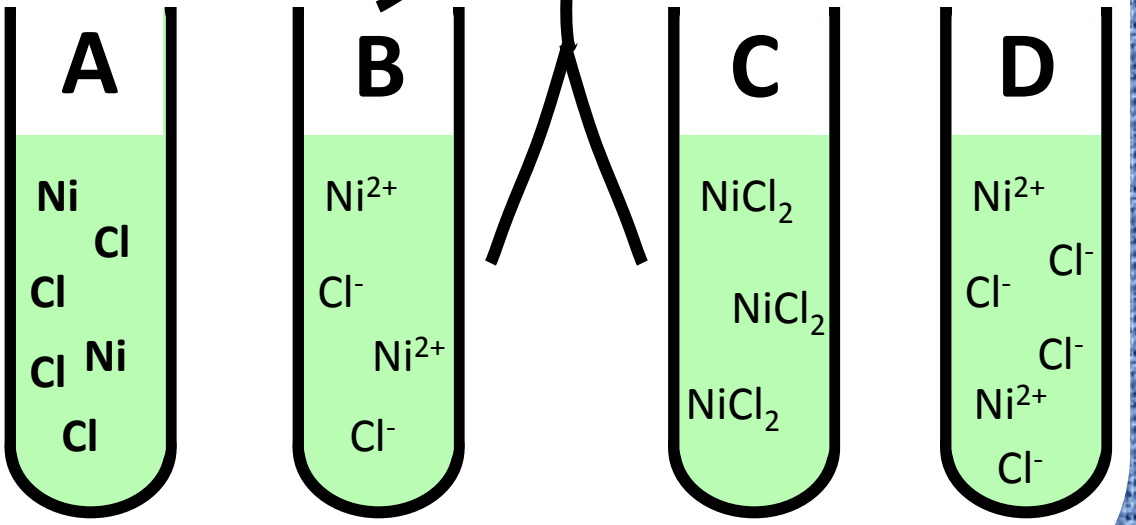
3. The reactions we will do today – Part B

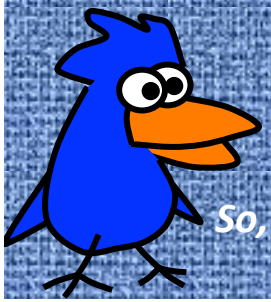


In Part B, we will be using two solutions – aqueous nickel(II) chloride and aqueous sodium carbonate.

Which of these test tubes best represents aqueous nickel(II) chloride?



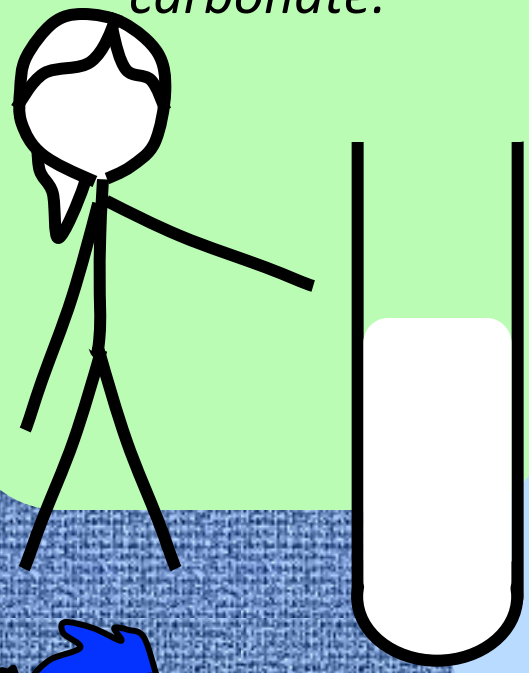




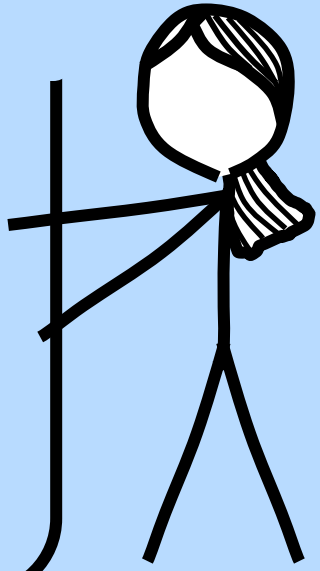
So, what is the answer?

3. The reactions we will do today – Part B

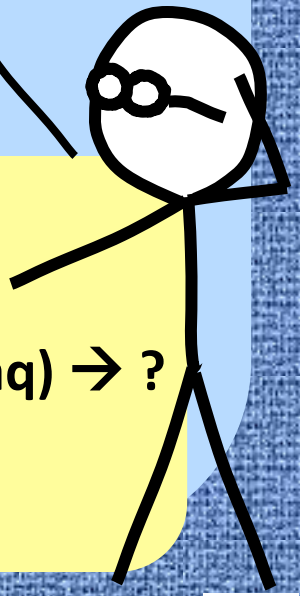
Sketch a solution of aqueous sodium carbonate.



Follow the lab manual procedure to add the two solutions in a little beaker. Record all observations.



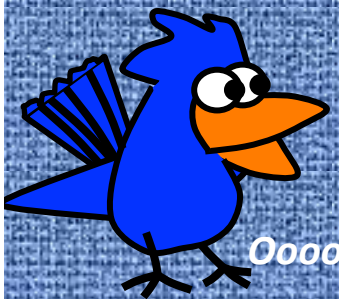
It's a precipitate! Let's complete these three equations! Overall, ionic and net ionic.



$NiCl_2(aq) + Na_2CO_3(aq) \rightarrow ?$

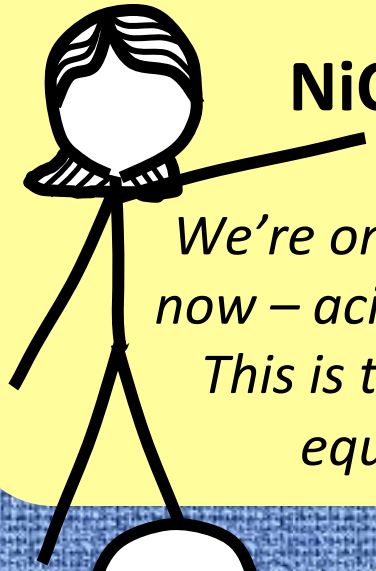
$Ni^{2+}(aq) + 2\ Cl^-(aq) + 2\ Na^+(aq) + CO_3^{2-}(aq) \rightarrow ?$

$Ni^{2+}(aq) + CO_3^{2-}(aq) \rightarrow ?$



Oooo! Oooo! Ions in aqueous solution!

3. The reactions we will do today – Part C-1

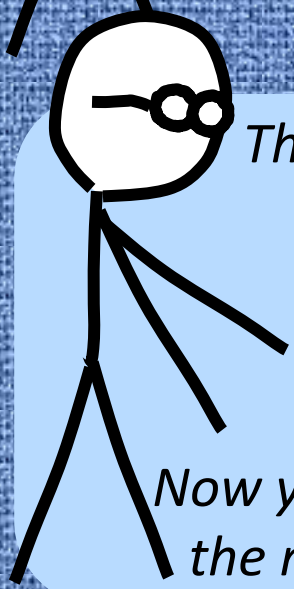


$$NiCO_3(s) + 2\ HCl(aq) \rightarrow NiCl_2(aq) + CO_2(g) + H_2O(l)$$

We're on to Part C1 now – acid reactions. This is the overall equation

Next we want to write the ionic equation. Solids are kept together, such as $NiCO_3(s)$. So are covalent molecules such as $CO_2(g)$. Strong acids dissociate and are written as ions. Instead of $H^+(aq)$, we prefer to write it as $H_3O^+(aq)$.

$$HCl(aq) + H_2O(l) = H_3O^+(aq) + Cl^-(aq)$$



This is the ionic equation – crazy, 'eh?

$$NiCO_3(s) + 2\ H_3O^+(aq) + 2\ Cl^-(aq) \rightarrow$$
$$Ni^{2+}(aq) + 2\ Cl^-(aq) + CO_2(g) + 3\ H_2O(l)$$

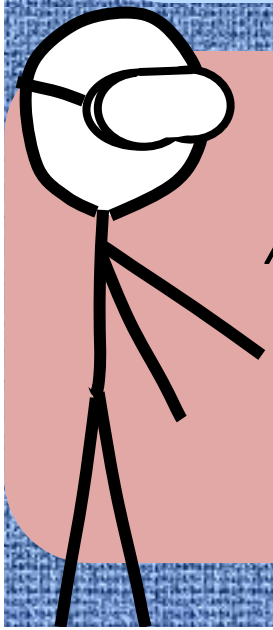
Now you can do the net ionic.

3. The reactions we will do today – Part C-2

$$MgO(s) + H_2O(l) \rightarrow Mg(OH)_2(s)$$

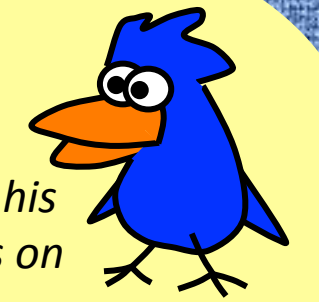
Lastly, we do Part C2. Magnesium oxide soaks up water moisture from the air, but that takes a long time. We can speed it up.

This type of reaction is called ***hydrolysis****.*



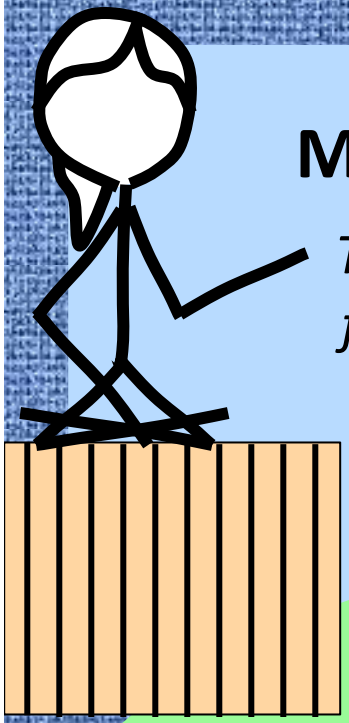
$$Mg(OH)_2(s) \rightleftharpoons Mg^{2+}(aq) + 2\ OH^-(aq)$$

A tiny bit of magnesium hydroxide dissolves – enough to turn phenolphthalein pink to indicate the presence of hydroxide. Sooo, magnesium hydroxide is a base!



He has his goggles on again

3. The reactions we will do today – Part C-2



$Mg(OH)_2(s, aq) + 2\ HCl(aq) \rightarrow 2\ H_2O(l) + MgCl_2(aq)$

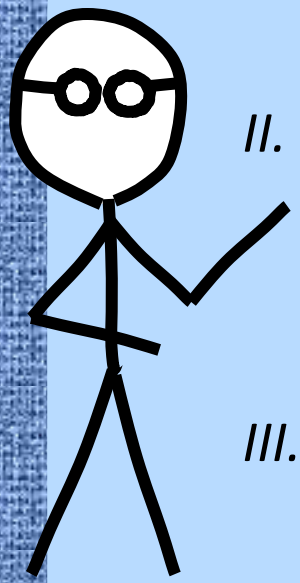
This is the overall equation for the acid-base reaction. Water is always a product of an acid-base reaction.

We can write $Mg(OH)_2(s, aq)$ because it is mostly insoluble, but a little dissolves as we saw.

You can do the ionic equation. Leave $Mg(OH)_2(s, aq)$ put together because it is mostly $Mg(OH)_2(s)$. Remember HCl(aq) is a strong acid written as $H_3O^+(aq) + Cl^-(aq)$. Water is covalent and stays together, but $MgCl_2(aq)$ is ionic.

And then do the net ionic equation.

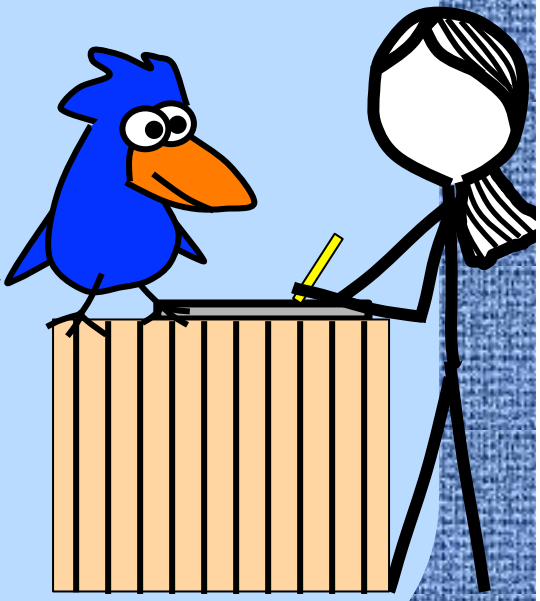
4. Summary



I. *Wear your safety glasses today. And we need to dress for a mess.*

II. *Follow the procedures as written, except that we will be doing Part A-3 ourselves. Dr Mattson will provide the piece of magnesium.*

III. *The cover sheet summarizes everything that you need to include with your report. There is an emphasis on observations and balanced reactions, including ionic and net ionic when appropriate.*



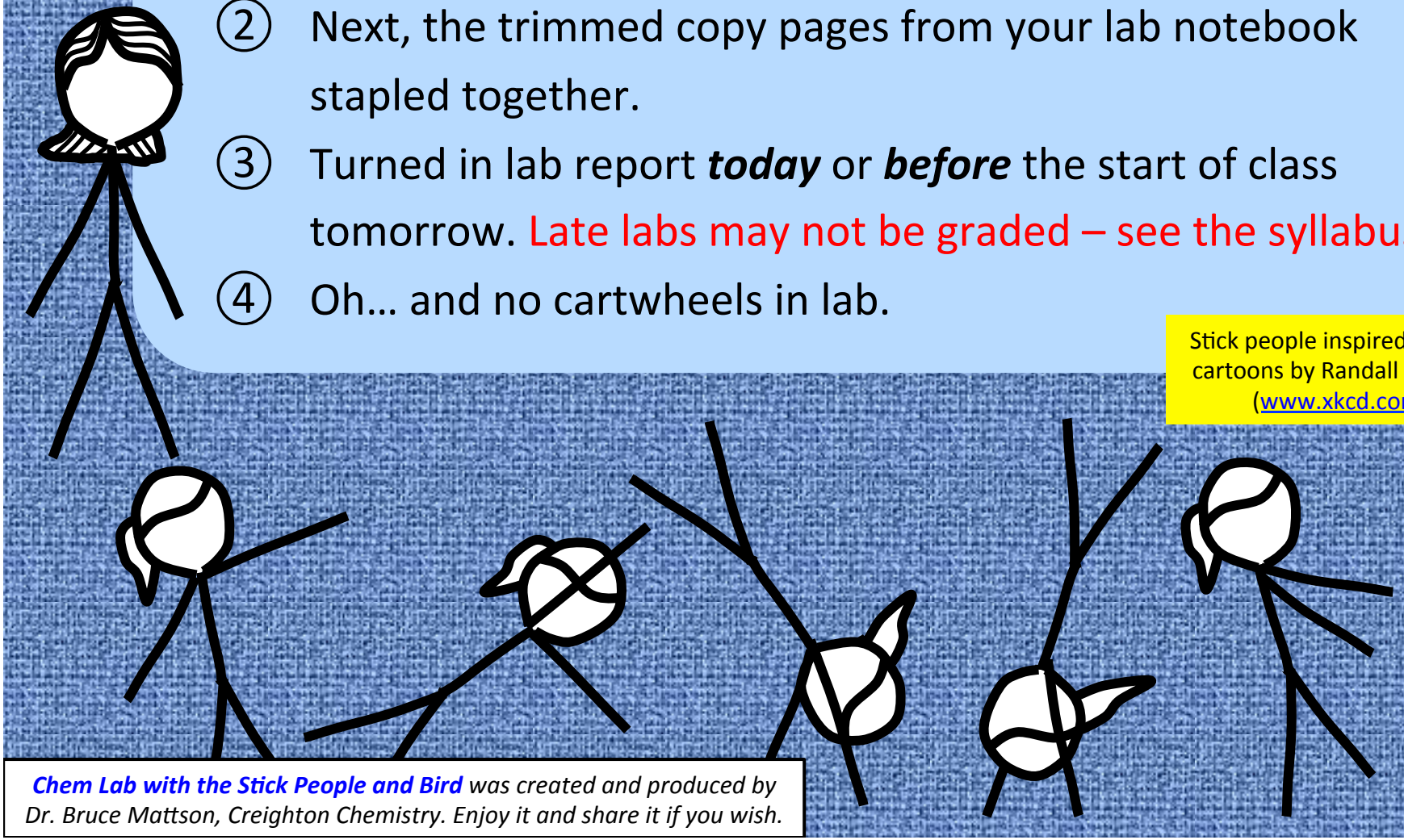
5. Your lab report.

① First, the cover page with TA initials.

② Next, the trimmed copy pages from your lab notebook stapled together.

③ Turned in lab report ***today*** or ***before*** the start of class tomorrow. Late labs may not be graded – see the syllabus.

④ Oh… and no cartwheels in lab.



Stick people inspired by xkcd cartoons by Randall Munroe (www.xkcd.com)

Chem Lab with the Stick People and Bird *was created and produced by Dr. Bruce Mattson, Creighton Chemistry. Enjoy it and share it if you wish.*