The Perfect Chemistry Course

by an imperfect instructor.

All Safety Equipment and Procedures Examined

You were hooked by the title. You can have your students hooked also. This is an engaging course for teachers and students. Just wait.

Some of the ideas may seem unconventional or out of sequence, but there is hope of method in this madness. Much of the course will spin off of some reactions encountered the first day of class.

The physical setting is based on a 6 x 6 matrix well plate where all reactions are recorded. The well plates can be purchased from Flinn for around $5-6. Solutions are stored in plastic dropper bottles. Most of you teachers have run this matrix a number of times using your own solutions. From the reactions observed, inferences can immediately be drawn, such as whether anything happened at all or not, color of precipitate, or effervescence. They are doing CHEMISTRY!

Teachers are responsible for making their own solutions. I have listed compounds and molarity.

Silver nitrate ($AgNO_3$): The molar mass of $AgNO_3$ is 169.87 g/mol. To prepare a 0.1M solution, we need to dissolve 16.987 grams of $AgNO_3$ in 1 liter of water.
- Sodium carbonate (Na_2CO_3): The molar mass of Na_2CO_3 is 105.99 g/mol. To prepare a 0.1M solution, we need to dissolve 10.599 grams of Na_2CO_3 in 1 liter of water.
- Sodium chloride (NaCl): The molar mass of NaCl is 58.44 g/mol. To prepare a 0.1M solution, we need to dissolve 5.844 grams of NaCl in 1 liter of water.
- Barium chloride ($BaCl_2$): The molar mass of $BaCl_2$ is 208.23 g/mol. To prepare a 0.1M solution, we need to dissolve 20.823 grams of $BaCl_2$ in 1 liter of water.

- Sodium hydroxide (NaOH): The molar mass of NaOH is 40 g/mol. To prepare a 0.1M solution, we need to dissolve 4 grams of NaOH in 1 liter of water.
- Sodium chromate (Na2CrO4): The molar mass of Na2CrO4 is 161.97 g/mol. To prepare a 0.1M solution, we need to dissolve 16.197 grams of Na2CrO4 in 1 liter of water.
- Lead II nitrate (Pb(NO3)2): The molar mass of Pb(NO3)2 is 331.21 g/mol. To prepare a 0.1M solution, we need to dissolve 33.121 grams of Pb(NO3)2 in 1 liter of water.
- Hydrochloric acid (HCl): Use 6M.
- Copper II chloride (CuCl2): The molar mass of CuCl2 is 134.45 g/mol. To prepare a 0.1M solution, we need to dissolve 13.445 grams of CuCl2 in 1 liter of water.
- Zinc chloride (ZnCl2): The molar mass of ZnCl2 is 136.29 g/mol. To prepare a 0.1M solution, we need to dissolve 13.629 grams of ZnCl2 in 1 liter of water.
- Sodium sulfate (Na2SO4): The molar mass of Na2SO4 is 142.04 g/mol. To prepare a 0.1M solution, we need to dissolve 14.204 grams of Na2SO4 in 1 liter of water.
- Magnesium sulfate (MgSO4): The molar mass of MgSO4 is 120.37 g/mol. To prepare a 0.1M solution, we need to dissolve 12.037 grams of MgSO4 in 1 liter of water.

The student will add a couple of drops from A1 to a couple of drops from B1. Record the event using color change, effervescence (fizzy), precipitate formation (something did not dissolve).

All of the reactions are listed in the table below:

If nothing happens, label the cell as NR.

If a solid forms, label the cell as ppt.

If it fizzes, a gas has formed.

B	**$Pb(NO3)_2$**	**HCl**	**$CuCl_2$**	**$ZnCl_2$**	**Na_2SO_4**	**$MgSO_4$**
AgNO3	**NR**	**AgCl**	**Ag Cl**	**AgCl**	**Ag_2SO4**	**Ag_2SO_4**
Na_2CO_3	**$PbCO_3$**	**CO_2 gas**	**$CuCO_3$**	**$ZnCO_3$**	**NR**	**NR**
NaCl	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**
$BaCl_2$	**NR**	**NR**	**NR**	**NR**	**$BaSO_4$**	**$BaSO_4$**
NaOH	**$Pb(OH)_2$**	**NR**	**NR**	**NR**	**NR**	**$Mg(OH)_2$**
Na_2CrO_4	**$PbCrO_4$**	**NR**	**$CuCrO_4$**	**$ZnCrO_4$**	**NR**	**NR**

Using the Solubility Table, match the precipitates by choosing one from A with one from B.

Solubility Table
Common Ionic Compounds

	Group 1				Group 2			Transition Metals					
	NH_4^+	Li^+	Na^+	K^+	Mg^{2+}	Ca^{2+}	Ba^{2+}	Al^{3+}	Fe^{3+}	Cu^{2+}	Ag^+	Zn^{2+}	Pb^{2+}
F^-	sol	sol	sol	sol	insol	insol	sl sol	sol	sl sol	sol	sol	sol	insol
Cl^-	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	insol	sol	sol
Br^-	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	insol	sol	sol
I^-	sol	sol	sol	sol	sol	sol	sol	sol			insol	sol	insol
OH^-	sol	sol	sol	sol	insol	sl sol	sol	insol	insol	insol		insol	insol
S^{2-}	sol	sol	sol	sol		sol			insol	insol	insol	insol	insol
SO_4^{2-}	sol	sol	sol	sol	sol	sl sol	insol	sol	sol	sol	sl sol	sol	insol
CO_3^{2-}	sol	sol	sol	sol	insol	insol	insol				insol	insol	insol
NO_3^-	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol
PO_4^{3-}	sol	sol	sol	sol	insol	insol	insol	insol	insol	insol	insol	insol	insol
CrO_4^{2-}	sol	sol	sol	sol	sol	sol	insol		insol	insol	insol	insol	insol
$CH_3CO_2^-$	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol

sol — soluble
sl sol — slightly soluble
insol — insoluble
(blank) — compound does not exist

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At this point, the students begin asking about the names. What a wonderful chance to teach nomenclature. We are getting more Perfect.

The students now need to think about equations. They have written chemical formulas already.

Barium Chloride + Sodium Carbonate ======> Barium Carbonate + Sodium Chloride

$$BaCl_2 + Na_2CO_3 = BaCO_3 + NaCl$$

Here is where the instructor does their thing in Balancing.

Do you realize this could lead directly into stoichiometry?

Your students will have experienced 36 chemical reactions and

predicted what happened. It should transition the students in reactions between different compounds.

I have done this a dozen different ways. With High School as well as University. Its been very successful.

I believe in atoms and quantum numbers and other stuff I'm supposed to know about. You are the people who have had a lot of prep work and it is rewarding. You are the ones making it PERFECT!

William C. Willis