**Identifying Unknowns Lab**

Though the practice of chemistry involves a lot of equations and whatnot, you're undoubtedly aware that out in the “real world” chemistry involves solving problems. In this lab, you'll be given a very real problem to solve.

Your instructor will provide your class with a bottle filled with a solution containing some ionic compound dissolved in water. Your job will be to figure out what ionic compound is present in the bottle by combining small drops of the unknown with small drops of solutions with known identity. You've undoubtedly learned about precipitation in double displacement reactions, and it's time to use this knowledge and a solubility chart to identify your unknown solution.

Use your usual lab write-up format to present your results.

Good luck!

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*Note: Easier and more challenging variants of the lab are provided below, so if you read the following paragraphs and the lab seems to hard for your students, one of them should be a better fit.*

**Purpose of this lab:**

Students will be given a bottle containing an unknown ionic solution. By combining this solution with solutions of other ionic compounds and observing precipitates, students should be able to identify the unknown.

For example, let's say that the unknown compound is magnesium iodide. By combining this solution with silver nitrate, you'll see a precipitate of silver iodide while magnesium nitrate remains dissolved. Likewise, if you combine magnesium iodide with sodium carbonate, you'll end up with magnesium carbonate as a precipitate and sodium iodide will remain dissolved. Because the only compound that will have both results is magnesium iodide, this is the unknown.

Other compounds will be similarly well-suited to this sort of activity. The two that come to mind most quickly are barium hydroxide and zinc sulfate:

* When barium hydroxide reacts with zinc nitrate, a zinc hydroxide precipitate forms. When barium hydroxide reacts with sodium carbonate, a barium carbonate precipitate forms.
* When zinc sulfate reacts with sodium hydroxide, zinc hydroxide precipitate forms. When zinc sulfate reacts with barium nitrate, barium sulfate precipitate forms.

There are many other examples of where this would work, though it's probably easiest to use one of the above compounds I've mentioned because the answers are already given above. A solubility chart such as the one on Wikipedia (<https://en.wikipedia.org/wiki/Solubility_chart>) is probably a good bet – just make sure that the compound you choose is soluble and that there exist precipitates of both ions.

A caution: Your students will come up with lots of strange answers, some of which are reasonable and some of which are not. The key to this lab is not necessarily that they get the right answer – it's that they understand the scientific process and are able to assimilate the information in a way that makes sense. If your student comes up with any answer that's not what you intended, make sure you check to see if it's reasonable based on their data.

**Ways to simplify this lab:**

* Have the students identify only the cation in the compound. This will make the lab much easier to figure out and will require less time. Again, the solubility table cited above will provide a good example.
* Give students a limited selection of possible compounds. If you tell the story that this solution might contain zinc sulfate, sodium nitrate, *or* iron (III) chloride, it will give the students a much more focused place to start.
* Provide additional guidance. If you tell the students the basic methodology of how building a solubility chart can assist them, this problem becomes simpler. You may even want to use graph paper to ease this process along, where each square represents a small area to combine drops of unknown to test for precipitates.

**Ways to make this lab more advanced:**

* Simply tell the students to “identify the ionic compound in this bottle.” This ups the difficulty level because your students won't know that precipitation reactions are even the right place to start.

**Safety warnings:**

The features you should keep in mind include (but are not limited to):

* **Goggles!** Always wear goggles, no matter what lab is performed!
* **Compound toxicity issues**: If you use compounds that are too toxic to wash down the sink (and you probably will), make sure that your students place them into marked disposal containers and that they wipe down their lab area after the lab is complete. It's also important that the students wash their hands after the lab – there has been a growing trend for students to use hand sanitizer instead, and this is clearly not a good substitute for chemical contamination.
* **Other unforeseen issues**: As you already know, one can never tell what might present a problem in the class. Keep a close eye on the kids, and remember that *you* are the person responsible for their safety. I know these labs have worked *for me*, but can't guarantee that you'll have the same experience.