LAB. IMPLEMENTATION PROJECT

TOPIC: CHEMICAL BONDS

Lab Overview:

Chemical bonds hold atoms together in compounds. There are two basic types of bonds: ionic and covalent. Ionic bonds are formed when one or more electrons are transferred from an atom or group of atoms to another atom or group of atoms. Positive and negative charges (ions) are created due to the transfer of electrons and strong electrostatic forces hold the two charges together. In covalent bonds no electrons are transferred. Instead, the bonded atoms share electrons.

Physical properties of a substance such as its melting point, solubility, and conductivity can be used to predict the type of bond that binds the atoms of the compound. In this investigative lab, 11^{th} grade Chemistry 1 students were expected to carryout a series of tests on six compounds, make careful observations and complete a data table. Using their compiled data and the theory learned in class, the students were to classify the substances either as an ionic or covalent compound.

Objectives: -By the end of the Lab session students should be able to:

- Compare the melting points of the six solids.
- Determine the relative solubilities of the solids in water and in ethanol.
- Determine the conductivity of water solutions in the soluble solids.
- Classify the compounds into groups of ionic and covalent compounds
- Summarize the properties of each group.

Relevance to curriculum

The "Chemical Bonds" lab fitted logically into the chemistry curriculum. After covering the topic on the periodic table, the topic on the formation of ions and ionic compounds was taught. In this topic, students learned the differences between ions and neutral atoms. They were able to understand that ions were more stable than atoms since they had either lost or gained electrons, to acquire a noble gas configuration. They also learned that when oppositely charged ions were put together, there was a strong attraction between the ions, and a stable ionic compound could be formed. Students learned how to write chemical formulas correctly and how to name ionic compounds. Most students were able to predict the physical properties of ionic compounds from their structure. Covalent bonds were introduced next. The students understood that in this case, electrons were neither gained nor lost but shared. Non-polar covalent bonds formed when electrons were shared equally, while polar covalent bonds formed when the atoms sharing electrons have an electronegativity difference of more than 0.5. Students learned how to name covalent compounds, write molecular formula and draw Lewis structures. Molecular shapes and their effects on the properties of covalent compounds were also studied.

The "Chemical Bonds" lab was ideal in that it provided the students with an opportunity to experience the properties of both ionic and compounds fast hand, and to link what they learned in class with their lab observations. Most groups carried out the lab procedure successfully. Students were totally engaged in the lab activity, each consulting with each other and I. Most groups obtained relatively good results. I assisted them in summarizing their data at the end of the lab to make sure that every one was on track. For their homework, students were required to analyze their results, refer to their notebooks, and then make general conclusions about ionic and covalent bonds.

Preparation for Lab

Students had been informed one week in advance that they would be carrying out a laboratory experiment while being videotaped. The students were excited and looking forward to it. I asked students to review their notes on ionic and covalent bonds. The day before the lab, I took them to the lab where I demonstrated the set up and pointed out critical aspects of the lab. I also went over the lab safety rules. Students were given the lab sheet and reassigned to read it through for homework. No formal pre-lab reports were required since the lab procedure was simple, straight forward and easy to follow. The students were required to enter their data into the lab sheet, answer the questions at the end of the lab, and make conclusions as part of their homework assignment. A chapter test on chemical bonding was given as a follow up to the Lab.

Strengths and weaknesses of the Lab

The greatest strengths of this lab were its simplicity and utilization of basic lab apparatus and chemicals.
The lab procedure was relatively straightforward and the lab worked very well. Students were able to clearly observe differences in the properties of ionic and covalent compounds. For example, when the samples were heated, the covalent compounds melted within 1-2 minutes, while the ionic compounds did not melt at all. Ionic compounds dissolved in water and conducted electricity in solution form, but did not dissolve in ethanol. Covalent compounds dissolved in both water and ethanol but did not conduct electricity. The lab was a positive re-enforcement to the ionic bond and covalent bond theories we had just completed learning in class.
One weakness I observed was that the students could easily conclude from their observations that ionic bonds were strong, and covalent bonds were weak. It is important for the teacher to specify that during melting, it is the intermolecular forces not the intramolecular bonds that break. Therefore, covalent bonds are strong, but covalent compounds are joined together by weak Van- de- Waal forces, which break easily during melting.

How could it be improved?

This lab could be improved by adding other sample compounds to enable students to make generalizations based on a larger data base. Even better, the other samples should be colored to avoid confusion of compounds. Students could also be given an unknown sample and asked to classify it either as an ionic or covalent compound. They could also carry out further tests to identify the ions present in compound. For example students

could be asked to carry out the flame test, to identify the metallic ions present in the ionic compound.

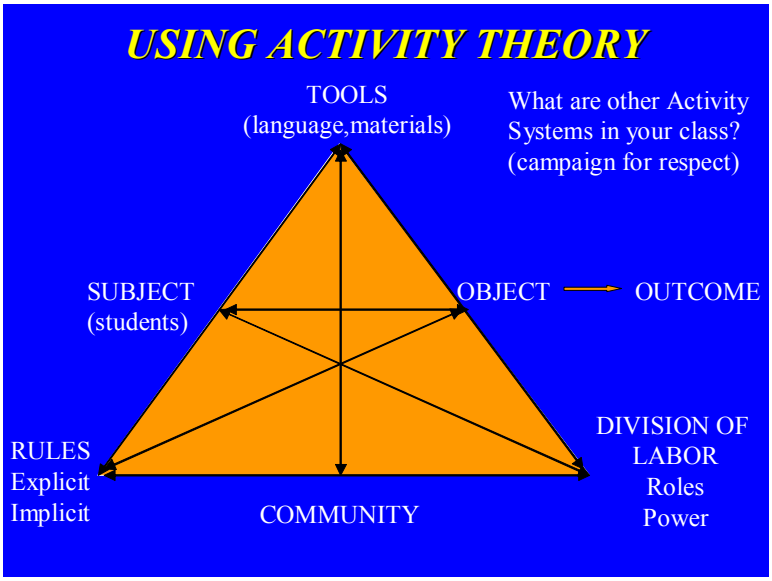
If I were to repeat the lab, I would have the students working in groups of two's to ensure that all the students actually handle apparatus and are more involved. I would use test tubes for the solubility test instead of the small wells, as this would enable them to use more water or ethanol, and be able to combine the solvents in order to make accurate and correct observations on their solubilities.

Ability Level

The lab was appropriate for 1st year Chemistry course in high school. My class was an 11th grade class. Most of the students in my class are below basic in their reading, mathematics and science skills, and would find it difficult to handle a complicated lab. This lab is suitable for a laboratory setting since gas and water are required, however it could also be carried out in a large classroom with tables, using portable burners or candles. A fume cupboard was not required in this experiment.
The lab could be modified to teach other contexts for example; a lesson on conductors and non- conductors, electrolytes and non-electrolytes, solubility, the flame test, lab safety, and how to handle apparatus.

Analysis of the implementation of Lab Video

I noticed that the students entered the laboratory noisily and took a long time to settle down. This is probably because they were excited to come to the lab and trying to look for their group members.



Reference: Dr. Kate Scantlebury

In this lab activity the students are the subjects (in the activity theory diagram); the object is to carry out the lab with the aim of achieving the set learning objectives.

When the students finally settled, I reviewed the explicit lab rules, and stressed that everyone should observe the rules for their own safety and for the safety of others. Other implicit "unspoken" rules were to be observed as well. Students were assigned to work in groups of four's and were given roles, to ensure division of labor and power between the students, with the teacher as a facilitator.

The students were required to read the instructions, set up the apparatus and carry out the procedure. This required the students to use "science tools" that comprise of the correct usage of lab materials and science language. From the video, I observed that most students did not have the language, which caused them to constantly call out to me for help or to confirm their answers. One chemicals (tool) phenyl salicylate was not available and the students were asked to skip the tests with this compound since I could not find a suitable replacement.

Majority of the students finally got good results and made correct conclusions, a few other students made incorrect observations because they either used too much solid in the dissolving experiment therefore the solid did not dissolve, or they used inadequate water rendering the solid insoluble. The lab was successful because all the students were actively engaged in the activity, which is an appropriate atmosphere for learning.