**A Lesson in the “Real World”**

In order for scientists to get grant money or scientific laboratories to get contracts, they both must prove to the consumer that they are worthy. In this activity, you will be working in groups of 2-3 simulating a laboratory team. You will be asked to solve a problem by designing an experiment, collecting data and coming up with a conclusion in order to receive the Big Contract. We will try to simulate as best we can the “real world”. You will also need to make sure that you use your resources well. The team that comes up with the best results (**design, data and conclusion**) will win the Big Contract.

**Your Goal:**

Your laboratory team is to design a procedure that will determine the heat of reaction for the following reaction:

 Cu2+ (aq) + H2 (g) 🡪 Cu (s) + 2 H+ (aq)

This reaction cannot be directly carried out in the lab. It would require an unachievably high pressure of hydrogen gas. You will need to design a procedure that will determine the heat of reaction indirectly.

**Point Scheme: This project is worth 100 pts**

 Paper: 90 points

 Use of resources: 10 pts

 Big Contract Award: 5 pts extra credit

**Characters**

*Lab Teams*: Each lab team will consist of 2-3 people – you may choose to be on any team you wish. Each team will need to come up with a team name and logo. I don’t want to know the actual members of the team when I’m grading the reports, so you will put your names on the outside of an envelope, seal it, and put the team name on the outside. Please try not to reveal which team you are on. It should only appear on the final copy of your report. **Team name and logo is due by 11/4 in an envelope.**

*Prospective client*: The Prospective Client is played by Mrs. Packard. The goal of this project is to design an experimental method that will determine the heat of reaction (in kJ/mol H2) for the equation above. Your job is to determine that method and present the solution in a formal paper. The Prospective Client will evaluate each paper and procedure and determine which Lab Team wins the Big Contract.

*Expert Consultant:* The Expert Consultant is also played by Mrs. Packard. You are welcome to ask questions of the consultant if you are having difficulty with the project. Just keep in mind that she is the best in her field and very expensive. Her fee schedule is outlined below:

* *Initial Consultation Fee is 1 pt. That is - just to ask a question (other than safety questions), will cost you 1 pt.*
* *You will have 1 minute in which to ask your question and clarify what information you need. After that, the expert will charge you 1 point for each additional minute that you take to make yourself understood.*
* *Then the expert will let you know how much the information will cost you. You may find that the information you need is very inexpensive. You will always be able to choose whether or not you want to buy the information from the expert.*
* *The idea is that you need to be clear about what you need, so that you are not wasting the expert’s time (and your points). You may find that spending a few points early will help you in your investigation.*

Keep in mind that you can ask other Lab Teams for help as well, but they may also charge you for the information. (Conversely, if another team asks for your assistance, you are welcome to charge for your help).

The Monarch High School Science Teachers have been advised of this project, and are aware of the barter system that we have in place. They have agreed to charge for any assistance they offer. They may feel free to charge anything they want.

**Rules of the Game**

1. You will be given 20 pts, in the form of ChemBucks, at the beginning of the game. 10 of these points are “free”, the other ten come from “use of resources” points. You may use these points to buy equipment (yes, even the equipment costs you - price list is included at the end of this description), hire the expert consultant, or pay any other character for information.

2. You must have your procedure checked by Mrs. Packard ***before*** you proceed. **All of the necessary safety precautions need to be explained thoroughly. Please have a materials list, and detailed procedure.** **Due by 11/4.** (Please note that just because you have the ok from Mrs. Packard, doesn’t mean that the procedure will work, or that it is “good”; it just means it is safe.)

3. Since you are working in groups of 2-3, you need to run the procedure 2-3 times. (There should be at least 5 “good” trials of your experiment.) You need to compare your results to make sure that the procedure is reproducible. You’ll need to look at the data collected, and see what changes can be made to improve your results.

4. Once you have come up with reliable data, you need to present your results. Each group must submit ONE paper, so the Prospective Client looks forward to reading excellent reports. The format for the paper is outlined below. Notice that the paper is worth 90 points. The other ten points comes from how well you used your resources, or ChemBucks. If at the end of the project, you have 8 ChemBucks, you get 8 points out of ten on use of resources.

5. Paper: **Due Friday, Nov. 22, 2013 Typed neatly with tables, equations and calculations**

* **Title Page** (2pts: Do NOT include all of your names. Include only your team name and logo, and the title of the paper.)
* **Abstract** There are a few websites that might help with this; the one below is still active: <http://writing.wisc.edu/Handbook/presentations_abstracts_examples.html> 5 pts)
* **Clear statement of purpose and design goals** (5 pts)
* Explanation of the **theory** used to answer the problem. The prospective client must understand the ideas behind the procedure you have run. This is the section where you explain the chemistry concepts needed to answer the question. This section should encompass the hypothesis as well. (12 pts)
* **Materials list** (including all safety and disposal information) (7 pts)
* Step by step **procedure** that was first followed in the lab. The Prospective Client MUST be able to reproduce your procedure exactly, and come up with the same results. If you made any changes as the experiment proceeded, you should then clearly explain the changes made to the procedure, and the rationale behind making these changes (12 pts)
* A summary of the ALL **data** clearly presented (9 pts).
* Clear mathematical **analysis** of the data to show how you determined the goal. Keep in mind that the water in which all the reactions take place also absorbs heat. (12 pts).
* **Conclusion** with an error analysis. (9 pts)
* **Post Lab Analysis:** Reflect on the error analysis and suggest possible ways to improve the protocol in order to make your results more accurate. (12 pts)
* **Reference** Page (5 pts) with at least 5 scientific references – refer to APA rules for citing references.

6. Clean up: If you do not clean up your lab stations appropriately each day, there will be a janitor’s fee assessed to your team. The janitor is also played by Mrs. Packard.

**Materials Price List**

**Glassware rental:** 2 ChemBucks for up to 3 pieces

**Thermometer:** 1 ChemBuck each

**Temperature probe and CBL:** 4 ChemBucks

**Strofoam calorimeter:** 1 ChemBuck each

 **The Deluxe Package:** 9 ChemBucks (this includes: Unlimited glassware rental, 1 CBL, 1 temperature probe, and Styrofoam cups setup to run two trials at once)

**Chemicals:** First order is free, if given on or before the due date.

 1 ChemBuck for each subsequent order.

 You are limited to 0.10 moles of each reactant for any order;

 extra 0.10 moles of reactant costs 1 extra ChemBuck per reactant.

 Distilled water is free at all times.

**Preparation of any solutions by the expert:** 3 ChemBucks – The expert has dilute acids and bases available to you at a molarity of 1M that can be included in your initial order.

**Due Dates:**

1. Team name and logo due by Monday, 11/4

2. Procedure due by Monday, 11/4

3. Materials supply list due by Monday, 11/4

4. Project Report due (1 per lab team) due by 11/22!