Cu Unlimited Project Calendar 2016-17

F 11/18	**TEST**: Section C.4-C.6 and Stoichiometry	Cu Unlimited Manager Meeting Monday before school or Monday after school on November 21st! Bring a copy of your Pre-meeting questions for your company CEO to look over!
M 11/21	Using Chemical Reactions to Retrieve Copper	Cu Unlimited Manager Meeting Monday before school or Monday after school on November 21st! Bring a copy of your Pre-meeting questions for your company CEO to look over! **Everybody:** Complete Prelab Questions for Cu Unlimited #1-4 **Class Managers:** Be prepared to lead tomorrow's discussion
T 11/22	Class Manager Introduction Pre-Lab Questions Discuss Controlled Experiments	**Team:** Have your procedure ready for when you return after the break and have Pre-Lab #5-6 completed. **Class Managers:** - Review events from the day - Be prepared for tomorrow - Evaluate team performances - Report team performances tomorrow to CEO
W 11/23 11:30 Dismissal	Class Manager Introduction Teams work on procedure and complete Pre-Lab #5-6	**Everybody:** Be prepared to start extracting Copper on Monday when we return!
R-F 11/24-11/25 **Thanksgiving Break**	**No School: Thanksgiving Break**	
M 11/28 **Late Start Day**	Class Manager Introduction Complete Team Experiment for Cu Unlimited - If Cu is isolated dry overnight - If no Cu let reaction sit overnight	**Teams:** Complete Post Lab Calculations #7-8 **Class Managers:** - Review events from class - Be prepared to deliver an introduction for tomorrow's events - Evaluate team performance - Report team performance to teacher tomorrow

T 11/29	Class Manager Introduction Mass Dried Cu - Complete Post Lab Questions #9-10 OR Isolate Cu to dry overnight - Set up work for Post Lab Questions #9-10 Recap Experiment So Far……	**Teams:** Complete First Experimental Conclusion Questions #1-2 (if possible) **Class Managers:** - Begin identifying best variables - Review events from class - Be prepared to deliver an introduction for tomorrow's events - Evaluate team performance Report team performance to teacher tomorrow
W 11/30	Class Manager Introduction Finish Reporting Data to Class Managers - Analyze Cu Unlimited Data - Complete #9-10 for Post Lab Questions if needed - Complete First Experimental Conclusion #1-2 if needed Class Manager Led Discussion - Decide and Design "Best Experiment" Create A Procedure **as a Class**	**Teams:** Complete "Best Experiment" Questions #1-5 **Class Managers:** - Create Finalized Procedure and Data Table for class to follow, print out 7 copies and bring to class tomorrow - Review events from class - Be prepared to deliver an introduction for tomorrow's events, - Evaluate team performance Report team performance to teacher tomorrow
R 12/1	Class Manager Introduction Each Team Completes the "Best Experiment" Isolate Cu and dry overnight - Set up work for "Best Experiment" Questions #6-10 Team Leaders Report Results to Class Managers	**Teams:** - Work on final lab write up Lab Write up for YOUR initial experiment (questions, procedure, data table, questions, etc) and "Best Experiment" Post Lab Questions and Conclusion …**one per group** (due Thursday 12/3) - Work on Team Building Reflection **Class Managers:** - Review events from class - Be prepared to deliver an introduction for tomorrow's events, - Evaluate team performance Report team performance to teacher tomorrow

F 12/2	Class Manager Introduction Mass Dried Cu - Give data to Class Managers - Complete "Best Experiment" Post Lab Questions #6-10 and "Best Experiment" Conclusion #1-2	Cu Unlimited Project due tomorrow! **Teams:** - Project due tomorrow Lab Write up for YOUR initial experiment (questions, procedure, data table, questions, etc) and "Best Experiment" Post Lab Questions and Conclusion …**one per group** (due Monday 12/5) - Team Building Reflection Due Monday 12/5! **Class Managers:** - Complete Class Manager Reflection (due Tuesday 12/6) - Complete Class Manager Lab Write Up (due Tuesday 12/6)
M 12/5	**Cu Unlimited Project Due!**	

USING CHEMICAL REACTIONS TO RETRIEVE COPPER

Purpose: To recover the maximum amount of solid Cu from a copper containing compound.

Background Information: Using Section B.6-Mining and Refining (p 102-103 text):
Define pyrometallurgy:

Define hydrometallurgy:

Define electrometallurgy:

Procedure Method 1:

DAY 1:

1. Measure out <u>approximately</u> 1 g of solid CuO into a 50 mL beaker. RECORD actual mass in the data table.
2. Add approximately 25 mL of 1 M HCl to the beaker containing the CuO.
   CAUTION: Extreme care should be taken with the HCl (hydrochloric acid). Wash hands immediately if it should get on your skin.
3. Gently heat your beaker to about 40° C on a hot plate set on low. Don't let the temperature get above 50° C. If it does, carefully remove the beaker from the hotplate using the "hot hands" or tongs and turn the hot plate down. Return the beaker to the hot plate after it has had time to cool down. DO NOT LEAVE THE THERMOMETER IN THE BEAKER WHILE HEATING!!!
4. Heat the beaker for 15 minutes stirring every few minutes with a glass stirring rod.
   The following reaction is taking place. While your beaker is heating, balance the equation and indicate states of matter of each substance.

$$\_\_\_\_ CuO(\ \ ) + \_\_\_\_ HCl(\ \ ) \rightarrow \_\_\_\_ CuCl_2(\ \ ) + \_\_\_\_ H_2O(\ \ )$$

5. After 15 minutes, remove the beaker from the hot plate. Decant off liquid into a clean beaker. Throw away any remaining unreacted solid CuO into the garbage can.
6. **<u>RECORD ALL OBSERVATIONS IN YOUR DATA TABLE FOR STEPS 6-8.</u>**
   Add 3-4 pieces of zinc metal to the contents of the beaker. IMMEDIATELY cover the beaker with the watch glass, and allow it to stand for several minutes, stirring periodically to dislodge the copper from the zinc.
7. After the reaction has subsided, remove the watchglass and gently dislodge the solid copper that has formed on the surface of the zinc pieces. Continue to dislodge the solid copper from the zinc until you are convinced that the zinc has stopped reacting.
8. Using forceps, remove any remaining pieces of zinc into another beaker. Rinse the zinc pieces with plenty of water and then dry and save these pieces of zinc on a paper towel for another class to use.
9. With the beaker containing your recovered copper, CAREFULLY decant as much liquid as possible into another beaker. Dispose of this liquid in the waste beaker in the hood.
10. Wash the solid copper several times with distilled water, CAREFULLY decanting the rinse water into another beaker. Dispose of the rinse water directly down the drain.
11. Write your name IN PENCIL on a piece of filter paper. RECORD the mass of the filter paper in the data table.
12. Transfer your solid copper onto your pre-weighed filter paper. Place the filter paper onto the tray marked with your class period and allow it to dry overnight.

DAY 2:

13. Weigh your dried piece of filter paper and copper. RECORD in the data table.
14. Pat yourself on the back for successfully "Retrieving Copper!"
15. Dispose of your filter paper and copper into the trash can.
16. Calculate the mass of copper recovered in your data table.

DATA TABLE:

Mass of CuO	
Mass of filter paper	
Mass of dried filter paper and copper	
Calculated mass of recovered copper	
OBSERVATIONS of reaction in step 6-8	

QUESTIONS:

1. Write the complete balanced equation for the reaction between the zinc and your solution in step # 6.

2. Using p. 102-103 as a guide, rewrite the equation above using ONLY the metals and the metal ions.

   a. Identify the species that was oxidized. _____, and the species reduced _____.

   b. Identify the reducing agent. _____, and the oxidizing agent _____.

3. Using your observations from the data table, what happened to the solution color after you added zinc in step #6.

4. What caused the changes you observed in the solution color?

5. How can the color of the solution be used to indicate when the zinc metal has removed all of the Cu^{2+} ions?

6. To recover the Cu metal from the solution, you had to use other resources.
   a. What resources were "used up?"

   b. Where did each of them go?

7. The percentage of Cu in CuO is 75.0%. (ex: if you had 100.0 g of CuO, 75.0 g of it consists of copper, 25.0 % consists of oxygen.
   a. Considering how much CuO you started with, what mass of Cu should you have recovered? This is called the theoretical yield. Show your work!!

   b. Calculate your % yield by using the following formula:

$$\frac{\text{Amount actually recovered}}{\text{Theoretical Yield}} \times 100\ \%$$

8. Which of the three methods discussed in the Background Information was used in this procedure?

CONCLUSION:

***Copper Unlimited*™**

One of our company's main objective is to use various chemical methods to extract usable materials from available resources. We are considering purchasing the rights to to a newly found mine located in Salt Lake City, Utah called *Copper Unlimited.* This mine contains an ore known to contain the mineral copper (II) sulfate. Ultimately, the copper from the ore can be sold for a profit to businesses throughout the world. Before making the final decision to purchase the mine, preliminary testing must be done to determine the best experimental procedure for retrieving the highest quality and quantity of copper.
(*See following page for an organizational chart of how the company will be divided).*

YOUR TASK AS A CLASS:

- **As a class, you will be divided up into 4-6 teams. Each team will be creating a controlled experiment to test one variable to obtain high quality and quantity of copper.**
- **Have class discussions regarding your results to determine which variables gave you the best result**
- **Each team will run a second set of modified experiments from this comparison to get better results. You will be guided by your Class Managers in this process.**

YOUR TASK AS A CLASS MANAGER:

- **Attend one of the Class Manager's morning or afternoon meetings to address the initial plan.**
- **To produce an initial plan for your class to complete the project**
- **To collect/keep daily reports from the Team Leaders.**
- **To COLLABORATIVELY monitor and manage the progress of the class throughout the project by completing Pre-Meeting Questions (see back page), attending the Class Manager's Meeting, and communicating with teams and teacher regarding the progress of the project.**
- **Review all data from your teams' first set of experiments and determine the optimal conditions for retrieving copper.**
- **After the class has conducted the second round of experiments, COLLABORATIVELY write a lab report that takes into account the data from all of the experimental conditions for retrieving the highest quality copper.**
- **To INDIVIDUALLY reflect on your role as class manager (approximately 1 page doubled spaced).**

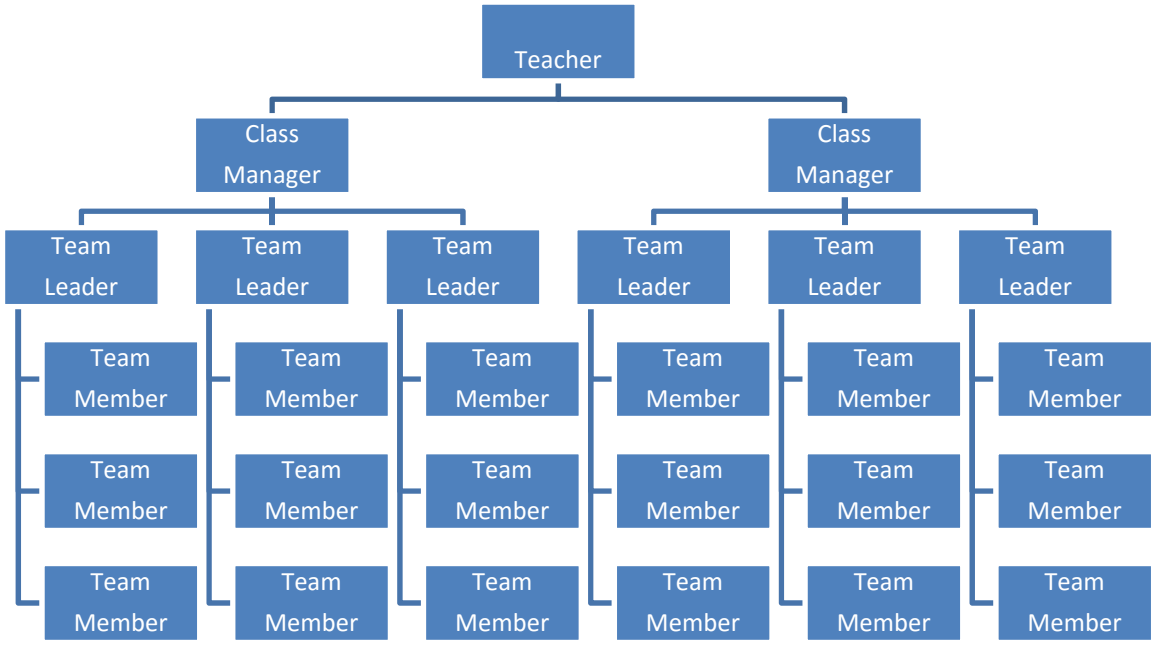
YOUR TASK AS A TEAM LEADER:

- **To lead your team as they run several experiments. Also, to guide the team as you and your team collaboratively write up one professional and detailed lab report which will include a procedure, pre-lab calculations, post-lab calculations and a conclusion. This lab report will include information from both the first and "Best Experiment" that are completed for the project. (See exact format on following pages).**
- **To fill out a daily log for your Class Managers to inform them of your progress and results.**

YOUR TASK AS AN INDIVIDUAL TEAM MEMBER:

- **To work under the guidance of your Team Leader to perform your team's experiments and to collaboratively work with your team to write a professional and detailed lab report which will include a procedure, pre-lab calculations, post-lab calculations and a conclusion. This lab report will include information from both the first and second set of experiments that are completed for the project. (See exact format on following pages**

Fill in the chart below with your class member's names.



COMPENSATION RUBRIC-PROJECT TOTAL = 50 POINTS

EACH EXPERIMENTAL TEAM MUST COMPLETE THE FOLLOWING!

LAB REPORT: 45 points max

Your report MUST be typed (with the exception of calculations which may be handwritten). There is a link to a WORD document of this report format on your class Sharepoint Site that can be used as a template for typing the report. Alternatively, you may use the attached report as a guide. Each small team will turn in ONE report for the team.

- Items typed in **bold** must appear **exactly as they appear** in your formal report
- Items written in *italics* should NOT appear in your formal report. Replace them with your own information.

45 POINTS:

- Up to 2 points for a clear purpose
- Up to 6 points for pertinent and complete background information
- Up to 4 points for a detailed and thorough procedure for the first experiment
- Up to 3 points for the data table for the first experiment
- Up to 4 points for post-lab calculations including sig figs
- Up to 2 points for a thorough experimental conclusion which answers the questions proposed on lab format for the first experiment
- Up to 12 points for "Best Experiment" post-lab calculations including sig figs
- Up to 12 points for a thorough experimental conclusion which answers the questions proposed on lab format for the "Best Experiment"
- Minus four points for a non-professional/non-typed report

Class Managers will determine if they want a copy of each team's lab write up.

INDIVIDUAL TEAM-BUILDING REFLECTION (NOT FOR CLASS MANAGERS!): 5 points

- Write a one paragraph (at least) reflection on how efficiently you and your team completed this project.
- Provide two suggestions on how your team's efficiency and overall organization could improve (this is imperative since you will be doing a team project in the spring worth approximately triple the points).
- **Each person (except the Class Managers) must complete this reflection!**

The Final Report and Reflection is due to the teacher at the beginning of class on Monday, December 5th.

CLASS MANAGERS MUST COMPLETE THE FOLLOWING!

CLASS MANAGER: Each Class Manager earns their OWN 50 pts by completing the following.

MANAGEMENT AND MONITORING: 14 pts (This must be done COLLABORATIVELY!)

- Up to 6 points for completion of Pre-Meeting Questions (See back page)
- Up to 2 points for attending either morning or afternoon Class Manager's Meeting
- Up to 6 points for Daily Operations and communicating with Team (Teacher Evaluation)

LAB WRITE UP: 25 pts For the following lab write up combine the data/results from the class's "Best Experiment" (This must be done COLLABORATIVELY!)

- Up to 2 points for a clear purpose
- Up to 5 points for describing the best approach for the company based on all experiments run by the class
- Up to 9 points for post-lab calculations (based on the experiment with the "Best Experiment") including sig figs (2 pts per question)
- Up to 9 points for thorough experimental conclusion which answers the "Best Experiment" questions proposed on lab format
- Minus four points for a non-professional/non-typed report

REFLECTION: 11 pts (This must be done INDIVIDUALLY!)

- What changes did you make to your original plan? **1 pts**
- How would you organize and run this project differently? **2 pts**
- List and explain at least 1 observation of the classroom dynamics that positively contributed to this project. **2 pts.**
- List and explain at least 1 observation of the classroom dynamics that negatively contributed to this project. **2 pts.**
- What are at least 1 thing that you did throughout this project that were helpful to the efficiency of the project? Explain why. **2 pts**
- What are at least 1 thing that you did throughout this project that were NOT helpful to the efficiency of the project? Explain why. **2 pts.**

The Final Report and Reflection is due to the teacher at the beginning of class on Tuesday, December 6th.

EVERYBODY MUST COMPLETE THE FOLLOWING!

TEAM EVALUATION: 5 points

- Each **CLASS MANAGER** will evaluate each **TEAM LEADER** based on their contribution, reliability and ability to work as a team leader.
- Each **TEAM LEADER** will evaluate each **CLASS MANAGER** and all of his/her **TEAM MEMBERS** based on their contribution, reliability and ability to work as a team.
- Each **TEAM MEMBER** will evaluate his/her **TEAM LEADER** and each **TEAM MEMBER** based on their contribution, reliability and ability to work as a team.

(*Names and class period**)

(your team must create a title)*

Purpose: *(You must generate a purpose that relates to the information given in the assignment. Read the ENTIRE assignment and lab report expectations before writing your purpose*).*

Background Information and Pre-Lab Calculations *(show all work BENEATH each typed question. Calculations may be hand written*)*:

A 100.0 g sample of the ore was crushed and added to 1.00 Liter of *(include the solvent used in your exp.)*
The copper (II) sulfate dissolved while the rock particles did not.
The mixture was filtered leaving the undissolved rock in the filter paper while the copper (II) sulfate solution dripped through. The rock was dried and massed and was found to be 54.1 g.

1. Draw a flow chart using simple sketches to represent what is occurring in the above passage.
2. You know that you have 100.0g of ore in 1.00 L of solution. Using a proportion, calculate the amount of ore in a 50.0 mL sample of the solution.
3. **Calculate how many grams of copper (II) sulfate were in the sample of the ore.** *(Show your work!! Calculations may be neatly handwritten!*).*
   = _____ g copper(II) sulfate in 1.00 L of solution
4. **You will use 50.0 mL of this solution in your experiment. Calculate how many grams of copper (II) sulfate will be in your 50.0 mL sample.** *(Show your work. Calculations may be neatly handwritten!*).*
5. **Write a complete balanced equation for the reaction of your metal(s) with the $CuSO_4$ solution.**
6. **Using stoichiometry and the above equation, calculate the EXACT amount of metal needed for the amount of copper (II) sulfate in your 50.0 mL sample.** *(Show your work. Calculations may be neatly handwritten!*).*

Safety Information: Goggles and closed toe shoes.

Procedure: ***NOTE: Each of your experiments will start with approximately 50.0 mL of the solution described in the background information. Be sure to record ALL actual measurements made in the lab including the volume of solution and the mass of the metal(s)!***
Use your "Using Chemical Reactions to Retrieve Copper" lab as a guide. Your written procedure should state EXACTLY what you did—be sure to bring your notebook into the lab so you can record exactly what you did. PLAN YOUR TIME WELL! DRYING OF SUBSTANCES TAKES ~24 HOURS.

Data Table: *This must be a computer generated data table for all data collected in the lab.*

Post Lab Calculations *(show all work BENEATH each typed question, Calculations may be hand written*)*:
If your experiment did not produce any copper, you must use data from another group in the class that DID produce copper for these Post Lab calculations!!!!!

7. **Write the balanced equation for the reaction(s) that occurred.**
8. **Using the initial masses of the metal and $CuSO_4$, calculate the theoretical yield (in grams) of copper.**
9. **How many grams of copper was actually recovered in the lab?**
10. **What was the percent yield of copper?**

<u>First Experimental Conclusion</u>: Address the lab that you performed, even if it did not produce copper!

1. **What were your results (address percent yield, quality, etc.)?**
2. **Answer the question below that pertains to your group:**
    - **If your lab did not produce copper, provide a hypothesis for why.**
    - **If your lab did produce copper, what are two non-human sources of error in your lab? How did these sources of error affect your results?**

<u>"Best Experiment" Post Lab Questions</u>

1. **Write the balanced equation for the reaction(s) that occurred.**
2. **Using the initial masses of the metal and $CuSO_4$, calculate the theoretical yield (in grams) of copper.**
3. **What is the percent composition of Cu in copper (II) sulfate?**

4. **In the Cu Unlimited mine there is known to be 750,000 metric tons of ore. How many kilograms of ore would that be?**
5. **Knowing that the ore is 1.0% copper (II) sulfate. What mass in kilograms of copper (II) sulfate can be extracted from the 750,000 metric tons of ore?**
6. **Given your answer to question 3 and 5, what mass of copper could be extracted from the mine?**

7. **Copper is known to sell for $2.39 per pound. How much money per kilogram would this be?**
8. **Taking your answers from the previous two questions, how much money could maximally be made from the Cu Unlimited mine?**

After you have weighed your final sample answer the following questions.

9. **How many grams of copper was actually recovered in the lab?**
10. **What was the percent yield of copper?**
11. **Based off of your answer from the previous question, how many kilograms of copper could be retrieved from the entire 750,000 metric tons of ore?**
12. **Based off of the previous question, what is the value of all of the copper we could have retrieved from the mine?**

<u>"Best Experiment" Conclusion</u>: Address the lab that you performed, even if it did not produce copper!

1. **What were your results (address percent yield, quality, etc.)**
2. **Answer the question below that pertains to your group:**
    - **If your lab did not produce copper, provide a hypothesis for why.**
    - **If your lab did produce copper, what are two non-human sources of error in your lab? How did these sources of error affect your results?**

Words in bold MUST appear in your final lab report.

*Words in italics should NOT appear in your final lab report. Italicized phrases are explanatory.

Cu Unlimited Financial Report

Employee Names _____ _____

_____ _____

	With A 100% Efficient Cu Retrieval	Cu Retrieval Based on Your "Best" Experiment
% Yield	100%	#10
Mass of Retrieved Copper	#6	#11
Value of Retrieved Copper	#8	#12

How much money do we expect to make knowing that this venture of purchasing and settin g up the mine will cost $5.5 million?

Should we scale up our procedure to produce copper on a large scale? Why or why not?

Experimental Design For Cu Unlimited

	Group #1	Group #2	Group #3	Group #4	Group #5	Group #6
Choice of Metal (See below)						
Dissolving Agent (Water, HCl, or NaOH)						
Temperature						
Surface Area of Metal						

Remember: Only one variable can be changed when compared to another experiment.

Your choices of metals are the following:

1. Iron strips
2. Tin tear drops (almost granular)
3. Lead strips
4. Granular Lead
5. Mossy Zinc
6. Granular Zinc
7. Zinc discs
8. Nickel strips
9. Aluminum discs
10. Mossy Aluminum
11. Granular Aluminum
12. Aluminum strips
13. Aluminum chips
14. Chromium chunks
15. Manganese chips
16. Granular copper
17. Magnesium strips
18. Magnesium chips
19. Granular Magnesium