Name _____ Date _____

A.P. Environmental Science

Office of Surface Mining &
Federal Bureau of Land Management
KriSCRo. Precious Material Corp.

Is it a Lab? ORE is it a competition?
Get your game face on and pickaxe out
cuz it's a little bit of both!
nom.. nom… nom…

Yes, that is Cookie Monster in a mining helmet … this is how us APES teachers roll … If you are already finding yourself way too cool for the C'Mon (that's his street name) and/or our next APES expedition, then you need to lighten up and stop taking yourself so seriously. Did you know that scientific studies have revealed that if you (yes you) "*move in the direction of taking yourself too seriously, whether that is manifested in terms of your career progression, your physical appearance, your kids' futures, your car or home, or a myriad other forms it can take, there are profound, negative consequences for your happiness?"* seriously – people have studied this! But let's get back on point. Yes there is a point. There is always a point. Even the Cookie Monster cameo has significance. Is he there to give you a warm and fuzzy childhood feeling? Is it because his expression of love is a foreshadowing of Feb. 14th? The reasons for C'Mon's presence here are truly endless!

This lab should not stress you - unless you truly lack manual dexterity or get stage fright. The worst thing you have to deal with today is the really bad attempts at wit and humor in the introduction to this lab (I realize it can be quite cringe-worthy). But, no matter how hard of a day or week (or year) you think you might have had here thus far, rest assured that it is not nearly as grueling as the life of a West Virginian coal miner. If you were a typical miner, at this point in the day you probably already hauled thousands of pounds of material, dodged falling objects, and even put out a fire or two. Your 10-hour day, 6-day week is spent underground in a dark, dank, cramped work environment, where your lungs are treated to your own personal share of toxic coal dust.

There are many stages to this lab experience and each role that you and your lab group members will assume will have a significant effect on your mining company's overall success (translated: your grade on this assignment!)

Jobs that you will undertake at some point in this simulation: **Excavator, Driller, Ore Extractor, Ore Processor, Land Restorer** . You will be instructed as to what these positions entail and will perform all these tasks "tag-team" style. (you'll see…)

Before we can proceed, you need to have a full understanding of the tasks that will need to be accomplished by the members of your group, and the activity as a whole. Make notes in the margin as to any instruction that is unclear to you, so that you remember to get clarification when we get to that stage of the simulation. If you don't read and understand your responsibilities, pay attention during verbal instruction and physical demonstration, and then perform according to those instructions, you will bear the responsibility of affecting the success of your entire group.

Each job will require a physical task that must be accomplished by each group member. Once we are underway, there will be no "order-switching" , "control-freak issues", dissention with the ranks, or bailing out of any specific task. If you don't perform your job well, your company's overall prosperity will suffer (a.k.a. lower grade on this assignment) If you decide to quit your job at any point, you can't pay the mortgage or feed your family (a.k.a. you fail ← seriously!). Aren't lab simulations of real life awesome?!

Stage 1: Obtaining a Mining Permit for a Specific Land Region

The U.S. Department of the Interior Bureau of Land Management: Mining Claims and Sites on Federal Lands

The Bureau of Land Management (BLM) manages more than 245 million acres of public land, primarily located in 12 western states, including Alaska. The BLM also administers 700 million acres of subsurface mineral estate throughout the nation. The BLM's multiple-use mission is to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations. The BLM accomplishes this mission by managing activities, such as outdoor recreation, livestock grazing, mineral development, and energy production, and by conserving natural, cultural, and other resources on public lands. The Federal Land Policy and Management Act (FLPMA) of 1976 provides that the public lands remain under the stewardship of the Federal Government, unless disposal is in the national interest and consistent with publicly approved land use plans, and that their resources be managed under a multiple-use concept that will best meet the present and future needs of the American people.

The Mining Law of 1872, allows citizens of the United States the opportunity to explore for, discover, develop, and purchase certain valuable mineral deposits on those federal lands that are open for mining claim location and patent ("open to mineral entry"). The law sets general standards and guidelines for claiming the possessory right to a valuable mineral deposit discovered during exploration, as well as establishing the right to develop and extract the mineral deposit. These "locatable" mineral deposits include most metallic mineral deposits and certain nonmetallic and industrial minerals. All mining claims must comply with all applicable laws and regulations, such as the BLM's surface management regulations.

Federal Lands Open to Mining claims or sites may be located in 19 states, including Alabama, Alaska, Arizona, Arkansas, California, Colorado, Florida, Idaho, Mississippi, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. The BLM manages the surface of public lands in these states, and the U.S. Forest 12 Service (USFS) manages the surface of National Forest System lands. The BLM is responsible for the subsurface minerals on both its public lands and National Forest System lands. Mining claims and sites may be prospected and located on lands open to mineral entry. Claims may not be located in areas closed to mineral entry. Subject to valid existing rights, these areas are withdrawn from further location of mining claims or sites. Areas withdrawn from mineral entry include national parks, national monuments, American Indian reservations, most Bureau of Reclamation projects, military reservations, scientific testing areas, most wildlife protection areas (such as national wildlife refuges), lands withdrawn pursuant to FLPMA, and lands withdrawn from mineral entry for other reasons. Lands withdrawn for power development are subject to mining location and entry only under certain conditions. Mining claims may not be located on lands that have been:

- Designated by Congress as part of the National Wilderness Preservation System
- Designated as a wild portion of a wild and scenic river
- Withdrawn by Congress for study as a wild and scenic river

There is usually a 1/4-mile buffer zone withdrawn from location of mining claims or sites from either side of a river while the river is being studied for inclusion in the National Wild and Scenic Rivers System. Additions to the National Wilderness Preservation System are withdrawn to mining claim and site location at the time of designation by Congress. Mining activities are permitted only on those mining claims from which proof can be shown that a discovery was made before the date of designation as wilderness by Congress. Lands patented under the Stock Raising Homestead Act of 1916, as amended, are open to location but may be entered, and mining claims located only under special procedures may be entered.

Pretty intense stuff huh? To obtain a real mining permit is a very extensive process. There are documents to be submitted, and then state and/or federal approval... rules and regulations… lots of legal jargon and then blah, blah, blah, blah … We have decided to approach this part of the mining expedition quite differently. To earn a mining permit and get first dibs on federal land with proven mineral reserves in this simulation, we have tremendously simplified this process with the magical randomizing Promethean SPINNER!! (with realistic sound effects …woohoo!) The order in which mining teams are chosen by the spinner is the order in which the mining teams get to choose their mining site. We will spin again to determine the order by which companies excavate, drill, and restore their land during stages 3, 4, and 7 of this simulation.

Note: The numbers in the parentheses indicate where to record your measurements/calculations on the Mining Report Sheet

Stage 2: Surveying the Land!

Now we realize that the area you are about to mine is not a "perfect" rectangle, but do your best to get relatively accurate length, width and depth dimensions of the solid rock and soil. (All measurements and calculations should be recorded to the nearest 10^{th} of a cm.)

Determine the area of land in cm^2 that will be affected by converting it to mine land. Record your calculation. **(1)**

Determine the volume of rock and soil in cm^3 that can be potentially affected by the mining. Record your calculation. **(2)**

Stage 3: Clearing the Land!

Your next task is to clear the land of all surface material. In this case, you will have to remove the "boulder" magnets and vegetative cover. To do so, your excavator needs to use heavy machinery to lift the boulders and trees out of the area to be mined. First, all the boulders need to be removed (one-by-one), and then the trees (one-by-one). You must use the tool in the designated way that will be demonstrated; your free hand may only be used to hold the cup that the waste material is being placed in. Every time one item is excavated, the tools will be passed on to the next worker in line. This is a timed event that will be performed in front of representatives of the Office of Surface Mining (the class). Save your cup of materials that were cleared from the site.

Record the time in seconds. (Since our stopwatches measure to the nearest hundredth of a second, we will record as such.) . **(3)**

Stage 4: Drilling to Locate the Underground Ore!

Now that the land is totally clear, the exact locations for the digging of the pits must be determined. This is accomplished by drilling to extract material to be sure that there is a sufficient concentration of ore present before actually digging begins. The ore extraction engineer will use the "drill" to accomplish this. The engineer will push the drill into the soil to find a location that will be dug out. Each land area has 2 locations that can be dug out as pits to retrieve ore. Temporarily mark the locations with a toothpick until it is time to dig the pits Once again, this will be demonstrated to you so that you can see the basic technique. Each group member will take turns drilling until the 2 ore locations are found.

Record how many times the area needed to be drilled to find the areas that pits will be dug . **(4)**

Stage 5: Ore Extraction!

By doing a little more probing with heavy machinery, your excavation team will scrape away the top layers of sediment with your terrain surface leveler to reveal the pit to be dug out. Make sure all sediment has been moved aside in the area to be dug so that the "pit" can be lifted out without sediment spillage. Use two hands to lift both pits that you have already located and measure the total mass of the material removed from each area using the digital scale. Record your findings to the nearest tenth of a gram. **(5,6)**

Place the weigh dish on the tray and gently use the terrain leveler to pry into the pit that you have extracted to lift out the ore from the weigh dish without spilling sand out of the dish. Once the ore is visible, use can your hand to pull it out. Shake off the excess sediment back into the weigh dish and then find the total mass of the ore extracted from each of the pits. **(7,8)**

Calculate the total sand/waste material from both pits after the ore is removed **(9)**

The sand from the pits (weigh dishes) can then be poured back into the excavated land area.

Stage 6: Ore Processing!

The next stage (and possibly the most important!) is to process the ore and obtain the valuable material that lies within it. Decisions need to be made as to what tools would best work to accomplish this task. It is up to each company to decide what tools they will purchase to get the job done. Each ore processor is allowed a dual-tool combo at the prices listed below and each processor at the site must use a different 2-tool combo. After you choose your 2 different duel-tool-combos, record your choices on the Mining Report Sheet. **(10)**

2 round toothpicks - $4000	forceps and round toothpick - $6000	forceps and scoopula - $7000
scoopula and round toothpick - $6000	2 scoopulas - $7000	forceps and micro-spatula - $8000

Stage 6: Ore Processing! (continued):

Once everyone is ready to proceed with ore processing, the following rules must be followed:

1. All work is to be done on a large plastic tray.
2. Safety glasses must be worn the entire time of ore processing.
3. Fingers /hands/mouth may NOT be used at any time to maneuver materials.
   (inspectors from other mining teams will have a watchful eye to prevent mining infractions)
4. The valuable material extracted must be clean of rock material and placed in a clean weigh dish.
   (the future buyer of the valuable material reserves the right to not purchase anything s/he deems tainted)
5. 2 ore processors will be working at the same time and have 4 minutes to retrieve as much valuable material as possible . Then 2 new ore processors will have 4 minutes to complete the job.
6. At the end of the 8-minute processing time period, the ore processors must present the valuable material to the buyer (that would be me), for a final inspection and weighing. Record the masses (to the nearest tenth of a gram) of valuable material accepted by the buyer after weighing **(11,12)**

Stage 7: Reclamation of the Land: Regrading and Replanting

The Surface Mining Control and Reclamation Act of 1977(SMCRA) is the primary federal law that regulates the environmental effects of mining in the United States and required that all mining activities had a plan for reclamation after the mine was exhausted. SMCRA requires that companies obtain permits before conducting surface mining. Permit applications must describe what the pre-mining environmental conditions and land use are, what the proposed mining and reclamation will be, how the mine will meet the SMCRA performance standards, and how the land will be used after reclamation is complete. Costs associated with land restoration activities can be substantial; one estimate suggests US$1.5 million per mine, although varied mine sizes and state regulations could result in wide fluctuations in cost. Now that your mining operation has been completed, it is your company's responsibility to reclaim the mine by using machinery to regrade the disturbed land and replanting vegetation as agreed upon when you acquired your mining permit.

Your first task is to regrade the land that was disturbed. Regrading the land requires that the land slope is returned to its original gradient to allow for the natural drainage of water that occurred prior to mining activities. Bulldozers, sometimes with specialized surface levelers, are used to accomplish this task.

Using the proper leveling technique demonstrated, regrade the surface of the mined area. An inspector is on site to make sure the land is properly restored. Level the land until the inspector is satisfied with the results (once again, this is a timed event). Record the time it took to smooth and regrade the land, to the nearest hundredth of a second. **(13)**

The second step of reclamation is replanting the native vegetation. Using a heavy piece of machinery known as the tree spade, as well as a bulldozer (terrain leveler again), you will replace the trees that were excavated. Each tree removed in stage 3 of this mining expedition will be returned to the landscape. Each tree must be replaced using the tree spade (and terrain leveler to assist). Trees must remain standing; if any trees fall or is left leaning against any other surface, they will need to be replanted. Land reclamation will be accomplished tag-team style as was done in the land-clearing stage.

Record the time it took to replant all the trees. (once again, to the nearest hundredth of a second) **(14)**

Stage 8: Balancing the Books!

It is now time to do the math and figure out how lucrative your mining expedition actually was. Use your now completed **Mining Report Sheet** to perform the tasks on the **Mining Calculations/Analysis/Summary** pages. One copy of each will be submitted by your mining company for evaluation.

Mining Company Name _____

Mining Company Employees _____

Mining Report Sheet

1. Area of land to be mined (cm^2) _____

2. Volume of rock and soil potentially affected by mining (cm^3) _____

3. Time required to clear the land of boulders and trees (seconds) _____ (maximum = 90)

4. Number of drilling attempts to find the best ore locations _____

5. Mass of total material removed from pit 1 (grams) _____

6. Mass of total material removed from pit 2 (grams) _____

7. Mass of ore removed from pit 1 (grams) _____

8. Mass of ore removed from pit 2 (grams) _____

9. Total mass of sand/waste material from both pits after ore is removed (grams) _____

10. Tool combos chosen for ore processing _____ _____

11. Mass of valuable material extracted from pit 1 ore (grams) _____

12. Mass of valuable material extracted from pit 2 ore (grams) _____

13. Time taken to regrade land surface (seconds) _____

14. Time taken to replant trees (seconds) _____ (maximum = 90)

Mining Company Name _____

Employees: _____

Calculations / Analysis / Summary

CLEAR and ORGANIZED work needs to be shown for each calculation made

1. Even though your company only dug two pits, you do realize that the whole area has been affected by your excavation. Using the conversion factors, determine how many hectares of surface land has been affected in some way by this mining expedition. In this scaled model, 1cm measured using the ruler = 80 "real life" feet.
   (Conversion factor: 1 hectare = 107639 ft^2)

2. Before locating the actually areas to be dug, your EIS included the potential volume of land that could be affected by your excavation. If the average mass of 1 m^3 of excavated gravel is 1.8 tons, what is the mass in tons of the volume of land that could have been disturbed? (Conversion factor: 1 m^3 = 35.3ft^3)

3. Determine the total cost of land clearing, extraction and processing of the valuable material from the ore, and reclamation of the mine.

   a. Cost of Stage 3: Clearing the Land (Show work using dimensional analysis.)
      The clearing the land of trees and other debris costs $1600/day for lightly wooded lots.
      Every 2 seconds of land-clearing time is equivalent to 1 day of work.

      Total cost of land clearing: _____

   b. Cost of Stage 4: Drilling
      The drill itself cost over $620,000 (probably a little cheaper on Craig's List …), but we will not factor that into the equation, as we have left out other overhead costs (a.k.a. operating expenses) in this exercise …

      Each time your attempted drilling to find a good place to dig costs $6000.
      What were your total drilling costs? (show your work)

      Total cost of drilling: _____

c. Cost of Stage 5: Ore Extraction

The cost of the use of the terrain surface leveler to expose the pit has a flat rate cost of $4000.
In addition, the digging of the pit, dealing with the sand/waste material has a cost associated with it.
If 1 gram of waste material is scaled to .25 ton, and it costs $1000/ton for removal, what were the removal costs?

Cost of leveling and digging of pits: _____

d. Cost of Stage 6: Ore Processing

Each ore processor chose a set of tools to remove the valuable material from the extracted ore.
What was the total cost of the tools chosen to complete the job?

Total cost of ore extraction tools: _____

e. Cost of Stage 7: Land Reclamation

In this stage, the land was regraded and trees were replanted.
What was the total time to level the land and replant the trees
required to be in compliance with SMCRA? _____

Every 0.75 second of reclamation time is equivalent to $15,000.
Calculate the total cost of reclamation.

Cost of land reclamation: _____

Total Expenditures (a + b + c + d + e) =

4. What percentage of the ore extracted is actually valuable material? Clearly show all calculations.

5. Determine the value of the material extracted from the ore based on current market price.
Since the valuable material is more dense than the rock, it is scaled up in weight using the conversion factor:
0.5gram = .25 ton. Every ton of valuable material extracted can be sold for $600,000 USD.
Calculate the amount of money you made as a result of your mining efforts.

Value of valuable material extracted: _____

6. And finally … YOUR PROFIT!!!
How much money did your company net after all mining expense have been paid? Show your math.

PROFIT: _____

7. You had to purchase tools to extract the valuable materials from the ore.
What real-life mining *processes* do these "tools" really represent?

_____

_____

8. There are many parts of this lab simulation that analogous mining terminology is purposefully left out.
Looking back at the stages, clearly explain where the terms overburden, spoils, and tailings could be applied.

_____

_____

_____

Regional Mining Company Ranking: 1st 2nd 3rd 4th 5th 6th
(I will complete this part)