Mining Made Simple

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Name_____

Class _____

Mining is one of the most important industries in our society and has been for centuries. The resources taken from the earth are fundamental in providing us with the quality of life we enjoy each day from the cars we drive to our cell phones and computers. The food we eat was produced and/or harvested by machinery formed out of metals and mineral resources. Much of our food itself is fortified with various metals and minerals to help us maintain proper health. The clothes we wear are treated and coated with dyes created from a variety of elements. Some fabrics are completely constructed from mined materials.

Metals and mineral resources exploration and excavation are environmentally delicate and complicated businesses. It is difficult to be successful and turn a profit in this business. The costs and risks associated with mining are exorbitant. Land acquisition, labor, equipment, safety, and reclamation are the chief concerns of the mine owner. Mining companies are required by federal law to return the land they mine to its original, or an improved, condition. This process, known as reclamation, is a significant expense for the industry. The mining industry, like any other business, faces challenges to make itself profitable.

Vocabulary:

Mineral Ore

Tailings

Land Claim

Environmental Impact Assessment

Land Reclamation

Open Pit Mining

Mine Shaft

Mine Adit

Anomaly

MSHA

EPA

Objective:

The objective of this activity will be to successfully, operate an iron mine. As stated above, mining operators face many challenges in the successful operation of any mine. To understand some of these challenges, you will attempt to conduct a profitable iron mining business in an experiment that requires you to mine the iron ore **(chocolate chips)** from the land **(cookies).** You must run the most profitable and environmentally sound iron mining operation you possibly can and still make a profit.

Procedure:

A. Go to the bank Obtain the following:

1. Withdraw **$25.00** from your corporate account. This is your *life-savings* so you will need to spend it wisely.
2. A **Mining profit and loss worksheet**
3. A sheet of **grid paper**.

B. Return to your headquarters and name your mine:

Record the name of your mine on the report sheet.

C. Purchase your mining property (2 cookies).

Procedure: You must first determine what property you will purchase. It is important to keep in mind the fact that you need to make a profit. Some property will be rich in resources but very expensive to purchase where other property might be poorer in resources but more affordable for your company to purchase.

Geophysics is the study of the earth using several quantitative methods. One method used by mining engineers is the measurement of magnetic anomalies (differences in magnetism) in the ground surface. The pattern of the magnetic anomalies on a map can be used to mark out the details of **subsurface** geology including the locations of magnetite-bearing rocks. Your company is interested in locating magnetite (Fe_3O_4) which is a principle ore of iron with magnetic qualities. A strong magnetic reading (higher values in the legend) would indicate the possibility of an area rich in magnetite. The weaker readings (lower values) would then designate areas of less magnetite. Obtain from your geophysics consulting company a copy of the aeromagnetic satellite image (page 10) of the region you will be mining. Carefully look it over. The image shows the magnetic signatures of the region. The higher values indicate strong magnetic **anomalies** (irregularities). Observe locations **A**, **B**, and **C** on the Aeromagnetic Satellite Map. Use the key to the right of the map to determine the concentrations of ore at the different locations. The higher numbers indicate stronger magnetic anomalies. The problem is that the mineral rights to

location **"A"** are owned by another large corporation that wants a large cut of the mining profits therefore the purchase price of that property will be higher than the other areas that are not as ore-rich. See below for the prices of the properties. There is always the possibility that the ore-rich areas might contain enough ore for both companies to profit . . . and then maybe not.

Use any portion of your corporate funds to purchase whatever land you prefer. You have to make a choice as to which property to buy that will turn the best profit for your company. This will be your land claim. Remember that you will also have to purchase your mining equipment as well as pay for labor costs.

Purchase prices per plot (cookie):

Location A - $3.00 per plot

Location B - $5.00 per plot

Location C - $7.00 per plot

Record the price of your plot (cookie) on the report sheet.

D. Write your Environmental Impact Assessment (EIA):

The environmental impact assessment is your detailed plan for the mining operation and an important first step in beginning your operation. It should only discuss significant issues such as what property you're interested in mining and why. Will your mine be a deep shaft mine or a surface mine and explain why? What equipment will you be using to mine with and why. Provide evidence you have that will prove that your operation will be successful. Include what your projected labor costs will be, and most importantly who will benefit from your operation and who will not.

E. Write Your Reclamation Plan

You need to discuss exactly how your company will reclaim the property (return it to its original state) effectively when the mining phase is completed. For example; if your company constructs a shaft mine, how will you reclaim that property? If you construct a surface mine, how will you reclaim that property? How will you prevent the runoff of Acid Mine Discharge (AMD) the contaminated water from your mine leaching into the local groundwater? Legally you will need to maintain the property for 20 years.

Write your EIA using your company's official letterhead (your design).

Before mining can begin, your EIA must be approved by the federal Environmental Protection Agency (EPA) Deputy Administrator.

Have your EIA and Reclamation Plan approved by the EPA before you continue.

F. Survey the property

You must survey (investigate) the property to determine exactly how you will proceed with your operation. You have to remember that your property is surrounded by private property and it is the responsibility of your company to insure that the mining operation will not affect the surrounding properties.

Place your cookies on the grid paper and trace the outline of each cookie. Remove the cookies and count each square that falls inside the circles; you must **count partial squares as full squares**.

Total the number of squares and record that number on the report sheet. This will be your land claim.

G. Purchase mining equipment.

You can purchase more than one piece or type of equipment. If a mining tool breaks, it is no longer usable, and a new tool must be purchased.

Flat toothpick - $2.00 each

Round toothpick - $4.00 each

Paper clip - $6.00 each

Record the price of your mining equipment on the report sheet.

Your company is now ready to move on to the mining phase of your operation. You must wait at this point for all companies to be ready. The mining phase will be timed.

DO NOT CONTINUE BEYOND THIS POINT UNTIL INSTRUCTED TO DO SO.

H. Mining Phase

The chocolate chips represent the iron ore you are trying to recover. Separate the ore (chips) from the waste rock. Make two separate piles. One pile of tailings (waste rock) and a second pile of ore that will be sold.

You must only use your tools to recover as much ore (whole chips) as possible.

***You ARE NOT ALLOWED to use your fingers* to touch the cookie. You can only touch the mining tools and the paper.**

* The mining of your property will be timed at a labor cost to your company of $1.00 per minute with a 5-minute maximum time limit. You can stop at any time before the 5-minute mining period ends. Taking less time to mine your property will result in a lower labor cost for your company.

***All mining will begin when the signal is given. You must wait for the signal.**

When the mining phase of your operation is complete you may continue:

I. Sale of Recovered Ore:

When the mining period is completed, your company can now sell your recovered ore to the buyers (your teacher) at $2.00 per each chocolate chip mined. Any broken chips can be combined to form one whole chip. All ore will be purchased at the buyer's discretion.

On your record sheet, record the amount of money you received from the sale of your ore.

J. Reclamation Phase

After the property has been mined, your company, as per federal law, must put the land back to the same or better condition than it was before you began the mining phase. To do this you will use your tools to "reclaim" the property by placing the entire cookie (minus the ore) back into the original circled area.

Remember: No fingers or hands allowed!!!

Hands or fingers touching the cookie will be charged as a safety violation and your company will be fined $1.00 through MSHA (Mine Safety and Health Administration).

When your reclamation is complete, draw another circle around the reclaimed property (cookie pieces). Go on to the next procedure.

K. EPA Site Visit and Assessment

Before you can complete your mining operation the Environmental Protection Agency (EPA) Deputy Administrator (appointed by your teacher) will visit your property to assess your reclamation project. You will be charged $3.00 for every crack your company left in the land (the cookies) and $1.00 for every square outside the original circle that your reclaimed land affected.

L. Sale of Mining Equipment

Mining equipment can be sold as scrap to a local company.

Flat toothpick - $0.10 each
Round toothpick - $0.50 each
Paper clip - $1.00 each

Discussion Questions:

1. What was the most important factor in determining which property to purchase?

2. What was the most important factor in determining which tools to purchase? Discuss all tools, even if you purchased additional equipment.

3. Which tools or combinations of tools were harder or easier to use? Why?

4. Did your company turn a profit or did it lose money?

5. What tactics did you use to help your company turn a profit?

6. If your company lost money, how would you do things differently next time?

REPORT SHEET

1. Name of cookie mine _____

2. Property Cost (cookie) $_____
(Location A $3.00, Location B $5.00, Location C $7.00)

3. Land Claim (number of squares) _____

4. Equipment Cost:

Flat toothpick _____ x $2.00 = $_____

Round toothpick _____ x $4.00 = $_____

Paper clip _____ x $6.00 = $_____

Total Equipment Cost = ... $_____

5. Labor Costs: _____ minutes x $1.00 = Cost of removing ore (chips) $_____

6. Total Cost of Mining

Property cost **$** _____

(+)

Equipment Cost $ _____

(+)

Labor Cost $ _____

Total Mining Cost = $ _____

7. Sale of Ore to buyers:

Number of chips _____ x $2.00 per chip = $ _____

8. EPA Reclamation Fines:

Number of cracks _____ x $3.00 per crack $ _____

(+)

Number of squares over the original tract _____ x $1.00 per square $ _____

Total amount of EPA fines **=** $ _____

Profit / Loss Statement (How much did your company make?)

Life-savings = ...$_____

(-)

Total cost of mining . . . . . $ _____

(+)

Value of chips . . . . . .$ _____

(=)

Profit/Loss ($ left over) before reclamation . . . . . .$ _____

(-)

Total EPA Fines . . . . . $ _____

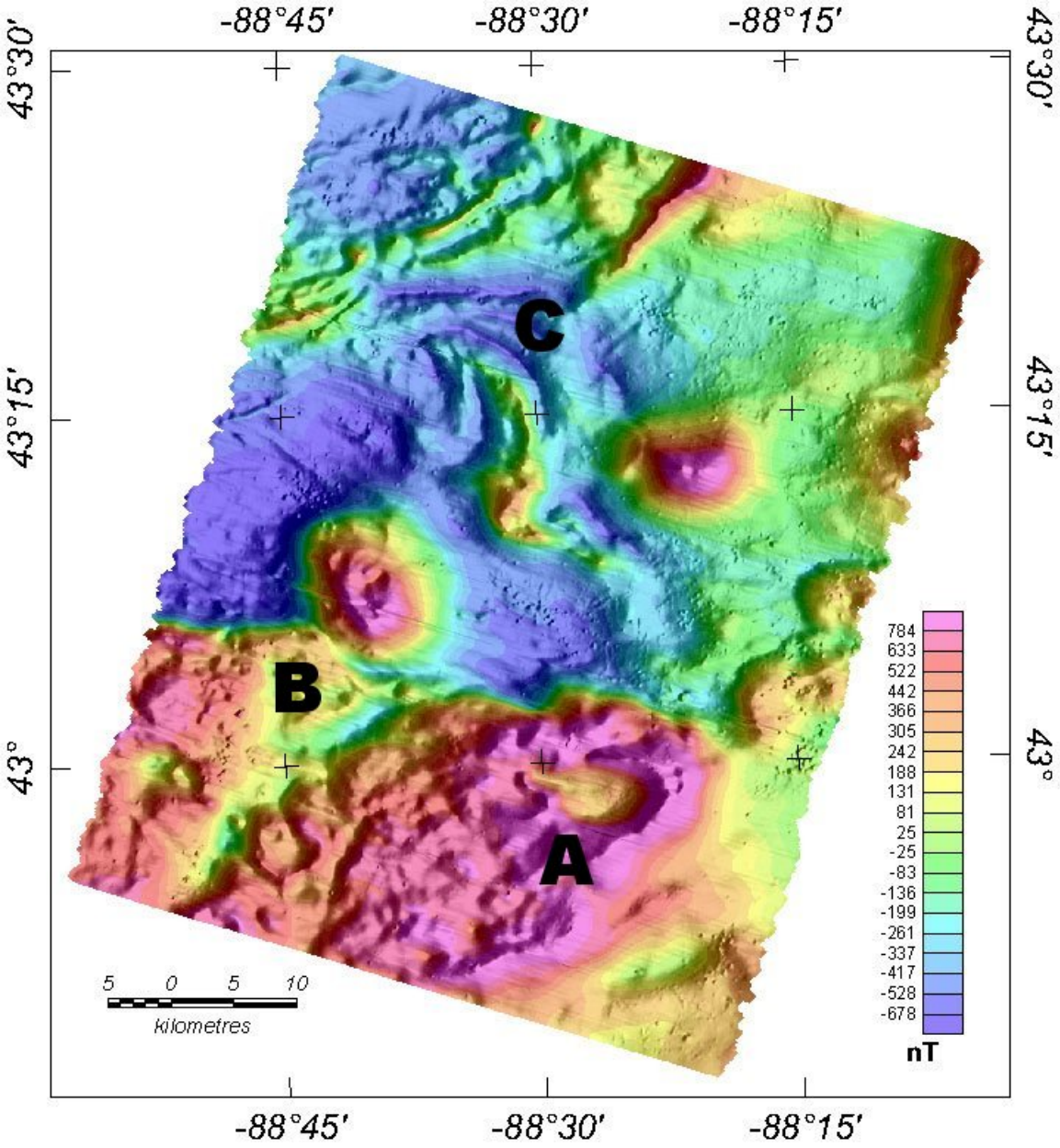
(+)

Sale of mining equipment . . . . . $ _____

(=)

Total Profit / Loss ($$$ left over) . . . . . .$ _____

Aeromagnetic Satellite Image



Teacher Notes:

- Appropriate for students in grades 8 – 10 but can be modified for other grade levels.
- Students should have been instructed in basic mining information prior to attempting the activity.
- Several good video tapes are available from the Empire and Cleveland Cliffs mines as well as on the Republic Wetlands reclamation project. All are located in Michigan.
- Allow at least 3 class periods for the activity
    - 1 period to write EIA
    - 1 period for the mining operation
    - 1 period for follow-up
- When purchasing cookies consider:
    - An inexpensive brand for property plot **C**
    - Chips Ahoy® for property plot **B**
    - Super Chunk or Deluxe Chocolate Chip for property plot **A**

Instruction in the geophysical development and use of magnetic field maps is needed.

Mine shaft house, Quincy Copper Mine, Hancock, Michigan

Designed by,
Eric Cohen, Westhampton Beach High School, adapted from other similar activities:

- American Coal Foundation - http://coal.summerproductions.com/
- http://www.coaleducation.org/lessons/primary/summary/economic.htm
- http://gushwalogy.org/APES/chocolate_chip_cookie_mining.htm
- http://www.nevadamining.org/education/projects/proj_951897600.html