Name:_____

Chapter 11: Geology, Soil, and Mineral Resources

Cookie Mining Lab Investigation

Every day people around the world consume various resources and understandably, without any consideration where the materials came from and what impact they may have had on the environment. Some raw materials are very common and easy to access, while others are quite rare or difficult to mine. In addition, many metals and minerals are often unevenly distributed around the globe, sometimes concentrated in a few small areas such as opals in Coober Pedy. Also, some mining extractions require more than others…. and sometimes are less economical and therefore, are abandoned for "cheaper" or "easier" techniques. Consider this idea as you work. In this lab, you will demonstrate mining of the earth's surface and underground, and will observe the limits of several energy sources.

In order make the mining simulation economically valid, many of the costs associated with real mining operations will be considered. Several of the economic considerations in this simulation follow.

** A land area will be leased from the land owner as well as being surveyed and quantified.*

** Mining equipment will be leased from mining equipment supply company*

** A mining operation will be undertaken, with the cost for each minute of the mining operation included in the total operating costs. These costs include labor, energy and insurance.*

** At the conclusion of mining operations, the reclamation of the land area is required, with a fine assessed for any part of the land area that is not successfully reclaimed and remediated.*

Materials 1 chocolate chip cookie dissecting equipment graph paper balance

Procedure

1. Place your cookie on a piece of graph paper and trace its outline. Record the number of squares that fall within the outline (surface area). Note: Partial squares count as a full square and **each square is 10 acre. Record the time your started mining: _____**

3. Based on the cookie's appearance and your own "cookie mining experience", predict the mass of chocolate deposits you expect to mine from your cookie: _____ grams.

4. Use the instruments at hand to begin mining your cookie. All mining must be completed using these tools (no fingers). Separate the chocolate ore deposits from the cookie dough tailings (also called overburden). This type of rock sometimes includes small traces of gemstones…. although rare, they can provide an added bonus to your revenue, but may incur higher processing & refining costs

5. Continue the process until you have excavated as much chocolate possible, then calculate the number of squares (acres) that are covered by the mine tailings. These squares (area of land) represents additional area that will need to be reclaimed (i.e. returned to a natural state.) **Make sure to do all your mining on the graph paper. Record the time your finished mining: _____**

6. Finally, mass your chocolate ore as well as your cookie tailings.

Data

Surface area of mine (1 square = 10 acre) _____ Surface area of tailings (1 square = 10 acre) _____

Mass of ore (chocolate chips (grams) _____ Mass of tailings (grams) _____

Mass of gemstones (grams)	Diamond _____ (clear)	Ruby _____ (red)	Sapphire _____ (blue)	Emerald _____ (green)	Citrine _____ (orange)	Beryl____ (yellow)	Amethyst ____ (purple)

Land Area Number of acres mined (number of squares occupied by cookie) _____ acres

Time Number of minutes spent mining _____ minutes

Mining Costs Calculations

Land lease (Number of acres x $11 per acre)	$_____
Mining equipment rental (Number of minutes X $5.50 per minute)	$_____
Labor expenses (Number of minutes X $7.50 per minute)	$_____
Insurance expenses ($0.35 per minute)	$_____
Energy expenses ($0.18 per minute)	$_____
Number of grams of mine tailings	_____ grams
Land recovery (returning mine tailings. $1.35 per gram)	$_____
Environmental reclamation and remediation ($2.35 per acre)	$_____
Mine tailing environmental contamination fine (shown by stain, $9 per acre)	$_____
Loss of old growth forest and or rain forest (no charge)	$ 0
Displacement of indigenous tribes (no charge)	$0
Carbon emissions (no charge)	$0
Bribery of local officials (costs per acre at your discretion)	*$*_____
Additional extraction costs if gemstones were found (price per gram)	$_____ (all gemstones)

(Diamonds - $84, Ruby - $42, Sapphire - $34, Emerald - $39, Citrine $18, Beryl $9, Amethyst $7)

Diamond $_____ Blue Diamond $_____ Ruby $_____ Amethyst $_____

Sapphire $_____ Emerald $_____ Citrine $_____

TOTAL COSTS **$_____**

Revenue

Number of grams of 'clean' chocolate ore recovered	_____ grams
Number of grams of 'dirty' chocolate ore recovered	_____ grams
Number of grams of diamond ($1625 per gram)	_____ grams
Number of grams of ruby ($1078 per gram)	_____ grams
Number of grams of sapphire (dark blue, $1022 per gram)	_____ grams
Number of grams of emerald ($915 per gram)	_____ grams
Number of grams of citrine (yellow, $778 per gram)	_____ grams
Number of grams of beryl (yellow, $321 per gram)	_____ grams
Number of grams of Amethyst (purple, $121 per gram)	_____ grams
Revenue of chocolate ore ($63.75 per gram for dirty chocolate ore)	$_____
Revenue of chocolate ore ($138.25 per gram for clean chocolate ore)	$_____

TOTAL INCOME **$_____**

REVENUE (TOTAL COSTS – TOTAL INCOME) **$_____**

Analysis

1. Was your mine profitable? What could be done to increase your profit margins?

2. Compare and contrast the number of chocolate deposits visibly observed and actually in existence.

3. What are some of the costs of mining that have not been included in this simulation?

4. Describe the following surface mining techniques:

Strip mining -

Mountain top removal-

Open pit mining-

Dredging-

5. Did you leave any chips behind in the cookie / tailings? If so, why?

6. Were you able to restore the land? How would compare the restored land compared to the area before you mined.

7. The average copper ore mined in 1900 was 5% copper by weight. Today the average copper ore is 0.5% by weight. What factors do you think account for this difference?

8. Summarize the key environmental impacts of mining?

9. What is an Environmental Impact Statement and when and how is it used?