

Mining for Chocolate



An activity adapted from the book, Family Engineering: An Activity Event Planning Guide, by Mia Jackson, David Heil, Joan Chadde, and Neil Hutzler

The Power of **Afterschool** and the Future of **Learning**

A Nebraska Afterschool Conference

**Planning and Implementing Family Science Events : Presented by
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MINING FOR CHOCOLATE

Engineering Fields

- *mining engineering*
- *environmental engineering*
- *geological engineering*

Engineering Concepts & Skills

- *modeling*
- *sustainability*
- *systems*

Estimated time: 35-45 minutes

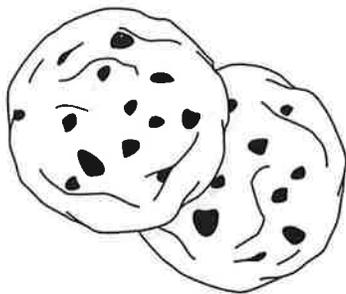
General Supplies

- *marker*

Supplies Per Family

(one set for each family or small group)

- *Mining for Chocolate Design Challenge (Appendix C)*
- *hard chocolate chip cookie (Chips Ahoy!® work well)*
- *soft chocolate chip cookie (Chewy Chips Ahoy!® work well)*
- *In a quart-size resealable plastic bag:*
 - pencil*
 - 2 paper towels*
 - 2 small white paper plates*
 - 2 toothpicks*
 - 2 paperclips*
 - 2 craft sticks*
 - plastic spoon*



Mining engineers try to extract the largest amount of mineral resources using the least amount of money but providing the greatest amount of safety for the miners. At the same time, engineers must minimize the amount of damage that they do to the environment. This is quite a challenge! In this activity, families will create a process for extracting the valuable resource of chocolate chips from a cookie while dealing with constraints on time, materials, and “environmental” impact.

Advance Preparation

- Make double-sided copies of *Mining for Chocolate Design Challenge* (one per family).
- Use a marker to label one paper plate “soft” and the other paper plate “hard” for each family. Alternatively, you can have families do this themselves with pencils after handing out supplies.
- Place family supplies into the plastic resealable bags for easy distribution. Cookies should be handed out separately. *Note: If soft cookies are stored in the same container with hard cookies, the hard cookies may get soft.*
- *Event Tips:* Have extra supplies and cookies available for large family groups that may need more than one cookie in order to allow everyone to be engaged in the activity. Also, to alleviate the temptation for eating the materials (cookies), you may want to provide additional cookies as a snack at the end of the activity.

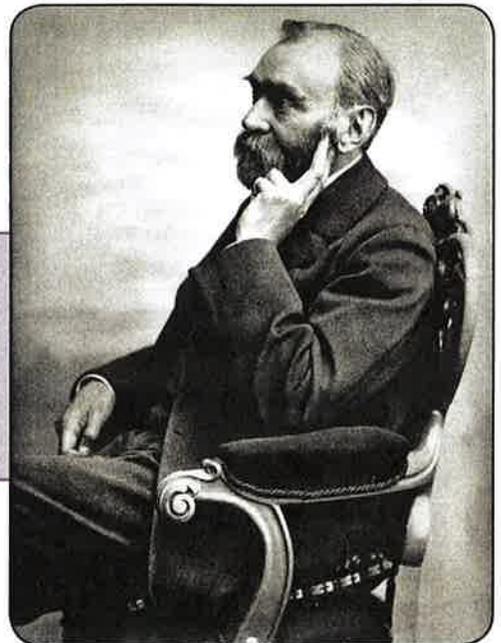
Activity Steps

1. Ask the group to think of things that humans extract, or mine, from the earth (coal, oil, gas, diamonds, iron, gold). Ask why they think we need these things. Explain that mining, or extracting resources, provides us with valuable materials or products that we use everyday, such as fuel for our cars, energy to heat our homes, raw materials for manufacturing things, or precious metals for coins or jewelry.
2. Explain that mining engineers design the methods and tools used for locating and extracting these resources. These engineers are also concerned with designing ways to prevent and/or repair the damage that is done to the environment as a result of mining activities.

3. Hold up two cookies, one soft and one hard, and explain that these chocolate chip cookies represent two different land types, each with a limited supply of a valuable resource—chocolate chips. Tell families that they are going to be a team of engineers and miners, hired to design and implement a process for mining the chocolate chips out of a cookie. The company has asked that you do the least damage to the cookie as possible during mining, because it will cost them to repair the cookie after the mining is done.
4. Distribute the *Mining for Chocolate Design Challenge* and a bag of supplies to each family, asking that they leave supplies in the bag for now. Review the design challenge, pointing out that engineers don't just design things, they also design methods and processes for getting a job done. Ask families if they have any questions about the challenge.
5. Have families spend about 5 minutes discussing and making plans for how they will mine the chocolate chips. Tell families to consider which tools might be best for the two different landmasses—soft and hard cookies—and how they might do the least damage to each cookie when extracting the chocolate chips.
6. Before handing out cookies, remind families that they should not eat the cookies. Have families place the paper towels from their bags on the table. Distribute one soft cookie and one hard cookie to each family on the paper towels. Ask families to NOT begin their mining yet, but rather to examine the two cookies and estimate the number of whole chocolate chips they expect to extract from each cookie within a 10 minute timeframe. Explain that mining engineers and geological engineers would analyze and test the landmass to predict how much of a resource is present and decide whether the landmass is a good place to mine. Have families record their estimates on the data sheets. Remind them to keep the chocolate chips extracted from each cookie separate using the two labeled paper plates, so that they can see how close they came to their original estimates. If plates are not labeled yet, have families label one “hard” and the other one “soft” using their pencils.

EXPLOSIVE INVENTION

Dynamite is often used in mining. Alfred Nobel is credited with the invention of modern dynamite, for which he received a patent in 1867. Alfred Nobel donated much of his money to create the Nobel Prizes in 1900.



7. Announce to the group that it is time to try out their mining tools and techniques. Remind families that engineers are always looking for ways to improve their designs, so they should feel free to change the mining process they have chosen as they go, or as they look around and see what is working well for others. Signal for families to begin mining—announcing that they will have exactly 10 minutes to extract as many chocolate chips as possible.
8. When the 10 minutes is up, call for everyone to stop mining and put down their tools. Have families count the number of whole and partial chocolate chips extracted from each type of cookie, record these amounts on the data sheet, and compare the count with the estimates made prior to the extraction. Discuss the reasons for any discrepancies between the two numbers. Ask the group if one land-type (cookie material) was easier to mine than the other. Did one land type yield more whole chocolate chips? Why? Explain that a mining engineer needs to choose the best place to mine. Engineers need to think about how much of a resource is in a particular place, and how much it will cost to either mine the resource from the land so that the land is not damaged or to restore the land after mining.
9. Explain that it is time to count up the earnings and associated costs from their work. Using the chart on the back of the *Design Challenge*, have each family add up the total value of their extracted resources (whole and broken chocolate chip pieces) and record this on their data sheet.



ENGINEERING CONNECTION

Engineering is involved in many aspects of mining. A geological engineer finds the mineral. A mining engineer figures out how to get the resource out of the ground safely and with minimal harm to the environment. A chemical engineer develops the process to separate the valuable resource from the rock so that it can be used. A civil engineer designs the roads and buildings at the mine. A safety engineer finds ways to protect the miners' health and safety. An environmental engineer tests the mine's air and water quality, as well as designing ways to reclaim the land—put it back to as close to its original condition as possible.



10. Remind the group that there are costs associated with environmental repair which will reduce their profits from the sale of the extracted resource. Have families set aside whole chocolate chips or chocolate chip pieces from their pile based on the "Cost of Environmental Repair" chart on the back of the *Design Challenge*. Have them add up what these chips are worth, and record this on their data sheets. Then have families subtract the cost of environmental repair from the value of the chocolate chips extracted. This is their net profit from the mining process.
11. Ask families to share which extraction techniques were most effective. Which were most destructive? Was their cookie in pieces after the 10-minute extraction? What changes would they make to their mining process if they tried it again? How do they think engineers solve the problem of "repairing" the earth's surface after mining?

Extensions

- ▶ Suggest that families try mining for items in other foods at home, such as seeds out of a watermelon, or raisins from a granola bar. Design tools and mining processes for each situation that can extract the materials with the least amount of damage to the "land."

MAKING REPAIRS

Restoring the land and environment after impact from a mining operation is called **reclamation**. This may include returning rock and soil to an open pit mine, removing waste or pollution generated by the mining activities, and covering the area with healthy topsoil and vegetation.



A mountaintop coal mine in Nicholas County, West Virginia before reclamation.



Another mountaintop coal mine in Logan County, West Virginia after reclamation.

MINING FOR CHOCOLATE

Design Challenge

Design a process for mining chocolate chips out of a cookie to get the most chocolate chips while causing the least amount of damage to the cookie.

Mining Process Design Requirements

- ▶ Use only the tools provided
- ▶ You will have exactly 10 minutes for your extraction
- ▶ Whole chocolate chips are worth more than broken chocolate chips
- ▶ Whole cookies cost less to repair than broken or crumbled cookies

Data Sheet

	One Soft Cookie	One Hard Cookie
1. Tool(s) selected for mining		
2. How many whole chocolate chips we think we can extract in 10 minutes		
3. Number of whole chocolate chips actually extracted over 10 minutes		
4. Number of chocolate chip pieces extracted		
5. Value of all chocolate chips extracted, both whole and pieces (use chart on back side of page)		
6. Cost of environmental repair (use chart on back side of page)		
7. Mining Net Profit (subtract #6 from #5)		

MINING FOR CHOCOLATE

Charts

(use these charts to complete the data sheet on the other side)

Value of Chocolate Chips:

Whole chocolate chip	\$1,000
Chocolate chip pieces	\$100 each piece

Cost of Environmental Repair

Condition of the Cookie	Number of Chips to Set Aside	Cost
Cookie still whole, only pitted	1 whole chip or 10 chocolate chip pieces	\$1,000
Cookie in 2 pieces	2 whole chips or 20 chocolate chip pieces	\$2,000
Cookie in 3 pieces	3 whole chips or 30 chocolate chip pieces	\$3,000
Cookie in 4 pieces	4 whole chips or 40 chocolate chip pieces	\$4,000
Cookie in more than 4 pieces	5 whole chips or 50 chocolate chip pieces	\$5,000

