Title: Lithium in Utah **Name_____**

Introduction: Lithium is a metal found in many Earth materials. In recent years it has been widely used in battery technology. Batteries provide energy storage necessary for alternative energy sources like solar and wind that capture energy but cannot store it.

What are the advantages of Lithium use in batteries?

Li-ion (lithium ion) batteries have one of the highest energy densities of any battery technology today. Li-ion battery cells can deliver large amounts of current for high-power applications. Li-ion batteries are also comparatively low maintenance, and do not require scheduled cycling to maintain their battery life. Li-ion batteries have no memory effect which may reduce the power of the battery. Li-ion batteries also have a low self-discharge rate of around 1.5-2% per month. They do not contain toxic cadmium, which makes them easier to dispose of than Ni-Cd batteries.

What are disadvantages?

Li-ion batteries have a tendency to overheat, and can be damaged at high voltages. In some cases this can lead to combustion. Li-ion batteries require safety mechanisms to limit voltage and internal pressures, which can increase weight and limit performance in some cases. Li-ion batteries are also subject to aging and frequently fail after a number of years. Another factor is their cost, which is around 40% higher than Ni-Cd. **Finally, despite the high energy density of Li-ion compared to other kinds of batteries, they are still around a hundred times less energy dense than gasoline.**

https://www.cei.washington.edu/education/science-of-solar/battery-technology/

Utah soils have lithium.

Lithium is relatively abundant. The trouble, experts say, is accessing and concentrating it. Minute quantities of lithium are scattered throughout soils across the globe, but in most cases, the lithium is so diffuse that attempting to mine it would never be sufficiently efficient.

Utah is an exception to this rule. Before it dried up 12,000 years ago, Lake Bonneville swept lithium from the surrounding rocks and concentrated the mineral in its sediment. That concentrated source of lithium remains present in Bonneville remnants around the state, including the Great Salt Lake, the Bonneville Salt Flats, and Sevier Lake. Underground reservoirs of saltwater brines that contain lithium are also scattered across southeastern Utah.

“In order to get these brines, you have an evaporative process working,” says Andrew Rupke, a senior minerals geologist for the Utah Geological Survey. “That concentrates ions in the brine, and that increases in concentration as you evaporate more and more water. Lithium tends to stay in the brine—you have to evaporate everything before you get lithium depositing as a solid.”

https://www.utahbusiness.com/lithium-mining-in-utah-is-a-big-deal/

Question: How can you extract the most "lithium" using the least energy?

Materials: **F**lasks of several sizes, evaporating dishes, hot plates, Potassium Nitrate (in place of lithium) solution, graduated cylinders, filter, funnel, scale, blow dryer (wind), heat lamp(the sun), hot plate (hydrocarbon fuel source)

Procedures:

1. Design a process to evaporate the water from 50 mL of the KNO3 solution (brine) your teacher provides. The goal is to reduce the water content quickly, use the least energy and produce the most KNO3.
2. Choose your materials from those provided and set up your equipment. Use the data table to find out the points for each choice. The goal is the LOWEST score except for the amount of KNO3 produced. Extra evaporation dishes require points. (extra large dish=-2 pts, extra small dish=-1 pt.
3. Draw your experimental set-up here:

4. You will receive your 50 mL of the "brine" at about the same time as other groups. Begin your process and keep track of the time when you start and when you finish. Your maximum time is 20 minutes.
5. When time is up, weigh the solid. Subtract the mass of the filter paper or weighing cup.
6. Fill in the data table with information from other groups in your class.

Data

Group #	Evaporation method	Energy Required high/med/low 16 8 3	Extra evaporation dishes	Time Needed high/med/low 6 3 1	Grams of KNO3 produced (rank order)
1					
2					
3					
4					
5					
6					

Followup questions

Analysis:

1. Which methods were most successful?

2. Which design used the least energy? Why?

3. Which design was most energy efficient? Why?

4. What advantages does Utah have in terms of mining lithium?

5. Name several devices you know of that contain lithium batteries: