

Lithium-Ion Battery, The Saviour of All Flappy Pigeons

A story of what's in the lithium-ion battery?

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It was a Saturday evening. The birds were singing their songs through the dusty window of the living room. Sebastian Friderich-George was sitting on his couch. His phone, playing the happy tune from his favourite game, *Flappy Pigeon*. The music echoed throughout the empty house, as his parents were absent, having dinner at their favourite restaurant, *McDanny's*. He had almost gold-starred the last level of the second world when everything was suddenly silent. The music had stopped. His phone was out of charge. "Oh, come on! I was about to finish that level, and it was so hard. Well, I guess I'll have to wait a couple of hours until my phone's charged to play *Flappy Pigeon* again." He was about to get up when the house started to shudder. The teapot on the counter was shaking, banging on a metal plate nearby. Suddenly there was a boom, and the southernmost wall burst open in a puff of smoke.

"HEY YOU!" There was a stranger silhouetted in the smoky haze.

"Whaa- me?"

"What are you doing, Sebastian?" Sebastian was frightened like mad.

"What do you want from me? Who are you? How do you know my name? ... Why are you in my house!"

"Never mind that now. Why are you sad about your battery dying? Your phone has a lithium-ion battery!"

"A lithium ia-what?"

"The lithium-ion battery is one of the quickest batteries there is, specially made for fast charging, so what are you doing? Go play *Flappy Pigeon!*" The man dashed back out through the now gaping hole in the wall.

After the mysterious stranger exited, Sebastian was awestruck. He gathered his bearings and looked at the hole. It was too large to fix for the time being, so Sebastian covered it with a large painting of *Money Lisa*, which his family had bought at an auction. Continuing to wonder what the stranger was talking about, he pondered what they had said. "How can phones charge incredibly fast?", he thought.

After 3 minutes of standing in the smoky living room, his curiosity got the better of him. He marched upstairs and climbed the ladder into the attic, where he had his gaming setup. *Craftmine* was still open on the launcher, the fan rumbling in the silence. He ignored it and opened *Gooleg*, the popular web browser. 'Lithium-Ion Battery', he typed into the search bar. A video popped up from *Youpipe*. It read, "Lithium-Ion Battery, the Fastest Charging Battery of the Century." He clicked on it, excitement running through him. A *Typingly* ad popped up. He grumbled, "Not this again." "Have you ever wondered if your writing was good enough? Well, *Typingly* can help-" he skipped the ad. As the video began, a tall man with a blue and red checkered long-sleeve shirt and beige pants popped up from the bottom of the screen. He had a red beard and glasses that looked too big for the size of his eyes. "Hey, all you gamers out there, you may be wondering what makes our phones charge so fast? Well that's all thanks to our good

friend, the lithium-ion battery, or li-ion battery for short.” Images fluttered across the screen.

“The lithium-ion battery consists of four main components, the cathode, the anode, the separator, and the electrolyte.” The components were highlighted, showing each one with arrows and labels. Sebastian was hooked.

“They each play a great role in the battery, so much that if you didn't have one, then the battery would not work. Today, we are going to focus on the cathode, what it does, and what it is made of. There will be links to my other series of videos in the end-screen theatre if you want to check them out. The cathode is the source of lithium ions in a battery, and is essential for determining the capacity and the average voltage of the battery. The energy of the battery is created by the fast reactions of lithium. However, since lithium is highly unstable in the element form, it is combined with cobalt, nickel, manganese and oxygen, to form a multi metal-oxide, to which lithium is then added. These materials are all non-renewable resources as well, so how do we acquire them for such a complicated product as the li-ion battery? Well, let's cover one mineral at a time.” Sebastian paused the video. The video reminded him to put his phone on charge. He plugged it into the wall, and the familiar 'beep' sounded. He swiveled his chair back to the small desk, on which his computer had the frozen image of the man. A very weird expression was plastered across his face, as usually happens when you pause videos. He tapped the space bar, and the video played. “First, we'll start with cobalt.” A small red-like rock appeared on the screen, it was shadowed on one side, and had lots of small engravings on it. “Cobalt comes mostly from the non-renewable mineral called cobaltite and is the most common mineral in phones. It is mined in many areas, such as England, Australia, and in provinces of Canada such as Quebec, Newfoundland and Labrador, Ontario, and Alberta. It is mined using the

quarry method, in which humans dig a large, mostly rectangular hole, from the surface down. They use heavy machinery such as cranes, dump trucks, and many other machines to excavate and transport the minerals to processing factories. Cobaltite is also used in many more common objects such as roof tiles, alloys for plane machinery, and even in some medicines." Sebastian was confused. He pictured swallowing a block of cobaltite to help with the flu. The thought disturbed him, sending hard chills up his spine.

"Before we get to the next mineral, let me talk about our sponsor, Rain Shadow Monarchs." Sebastian skipped ahead by 2 minutes, as he had already heard enough about Rain Shadow Monarchs. It was everywhere. " -And if you use code li-ion in the store, you'll get 500 silver and 200 copper pieces. Now back to the video." The screen swept to the side.

"The next component used in the cathode is nickel. Nickel comes from the also non-renewable mineral, garnierite." A green pebble-like rock flashed on the screen. "This mineral is mined in areas such as the U.S, China, and in the same Canadian provinces such as Quebec, Newfoundland and Labrador, Ontario, and Alberta. Garnierite is mostly mined in pockets and veins of weathered ultramafic rock. If you are wondering what ultramafic rocks are, I have another video explaining them, but to cut it short, they are mostly the kinds of rocks that make up Earth's mantle. More common uses for garnierite are in magnets (when combined with iron), and in ornamental pieces such as decoration. Also a fun fact: Canadian dimes, the ten-cent coin, are made out of nickel and steel plating, which is odd as nickels, the five-cent coins are made of silver." The human-made a pause, pushing his glasses farther up his nose, "While you are still here, don't forget to like and subscribe for more content like this." Sebastian certainly liked the video but didn't subscribe as he wasn't into science.

The man went on, "The third component used in the cathode is manganese, which comes from the mineral called pyrolusite." A grey, chunky-like rock appeared on the screen. "It is mined in Germany, the U.S, and one territory of Canada, (I'm sure you can see a trend here), being Nunavut, near Iqaluit, the capital. Pyrolusite is mined in pits similar to quarries, and can alternatively be mined in nodules underwater. After it has been mined, it is taken over to a processing plant to be smelted into manganese. The manganese in pyrolusite is used to increase the hardenability and tensile strength of steel and is also able to decrease the critical cooling rate when it hardens, making it one of the best minerals for steel. Moreover, used in many decoration agents for glass.

The final component of the cathode in the li-ion battery is lithium. Lithium is generally found within the mineral spodumene, and can almost be considered a lithium ore." A crystal-like grey and brown rock fluttered across the screen, and made Sebastian think of his glorious game of *Flappy Pigeon*. "Spodumene can be found mostly in places such as Brazil, the U.S, and some provinces of Canada, such as Alberta and Quebec. It can be mined in quarries and brines, however, although the concentration of spodumene within quarries is greater, its extraction is worse for the environment than from brines. It is used when making glass, steel, fluxing agents, and even some medicines." The dreadful image returned to Sebastian, but this time there were two blocks, one of spodumene and the other of cobaltite being swallowed at the same time.

"That is the end of the video. I hope you have learned something about the lithium-ion battery and specifically the cathode, and don't forget to stay tuned for the rest of the parts of the li-ion battery to really become a master. We hope you have a very wonderful day. Bye for now." The video ended. Sebastian was silently reflecting on what he had witnessed. "Hmmm, that went by

quicker than I thought, although it was kind of cool to know that mining is so prominent in our lives, and we don't even notice. I thought phones were made out of steel and plastic." He thought. Sebastian checked the charge on his phone. The picture of the battery was completely filled, and the number read 100%. "Wow! That *really was* fast, they were not lying.

As he trudged down the ladder and quietly slipped down the stairs, he heard the key to the door rattle. His parents were home. At that moment, Sebastian remembered the gaping hole where the painting of *Money Lisa* stood. His parents were through the door by the time he realized the amount of trouble he would be in when his parents found it... too late. His parents walked over to the painting. "Why is this painting on the ground, did you take it off?" They started to pick it up. Sebastian frantically tried to respond. "It was because - no, you really shouldn't - never mind." His parents had seen the hole, where a couple of squirrels had begun to nest. "Come here right now, young man! We are going to have a serious talk."

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