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Year 5-6

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Government of South Australia
Department for Education

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Moon Miner

Category: Computer Programming and Robotics

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Year Level: 5 - 6
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Objective

In this project, I have developed an **educational game "Moon Miner"** using Scratch Programming Language to demonstrate the idea of Mining the Moon. Earth is in an energy crisis due to depletion of non-renewable energy sources. For a long term solution, some scientists are turning to moon as a source of renewable energy. Moon can also provide an alternate source of rare metals and minerals.

The aim of my game is:

- To demonstrate how Moon mining can help us find rare resources on the Moon vital for Earth's future.
- To educate children in a fun way about the how Moon mining could work and teach them about lunar mineral composition.
- To inspire students to think about great possibilities and challenges associated with lunar exploration.

Scientific Purpose of Project

I. Why mine the moon

With expanding populations, advancing technologies and expanding industries, non-renewable resources on earth are depleting at an alarming rate. The fossil fuels have led the technological development of the world but we might runout of these non-renewable resources in near future as shown in Figure 1. The current goal of the energy sector is to use clean energy to reduce emissions and protect the planet. However, renewable energy relies heavily on access to rare minerals and metals. So experts around the world are looking to find some long term solution for reliable and clean sources of energy creating sustainability for future generations.

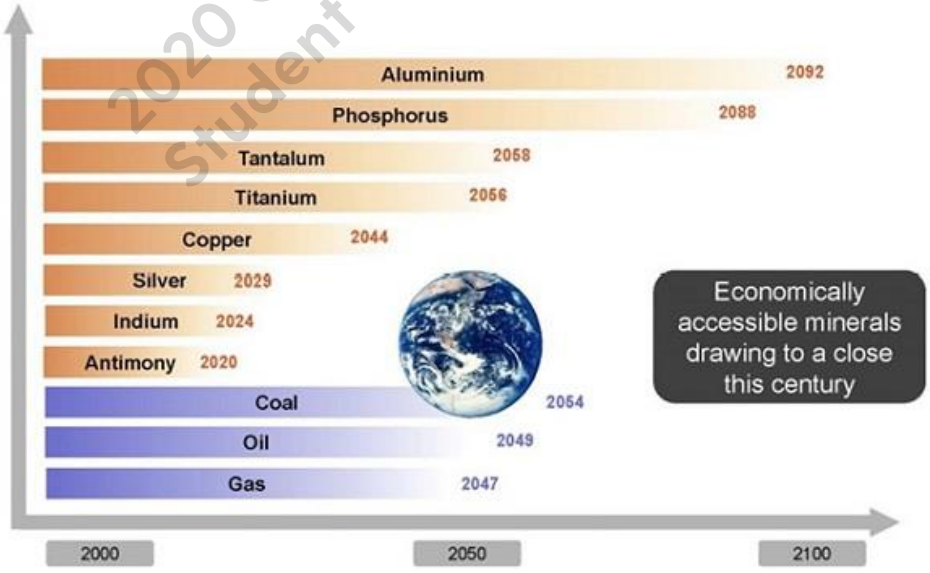


Figure 1: Projected shortages of economically accessible minerals
(https://room.eu.com/article/space-mining-the-reality-of-tomorrow)

Scientists are now exploring the possibilities of lunar mining, where vast resources have been deposited over billions of years of asteroid and comet bombardment. Geological surveys have previously shown that the Moon contains three crucial resources: water, helium-3, and rare earth metals. The Moon's resources can be used as a fuel for space exploration, or providing an alternate source of rare metals and minerals for use on Earth as shown in Figure 2.

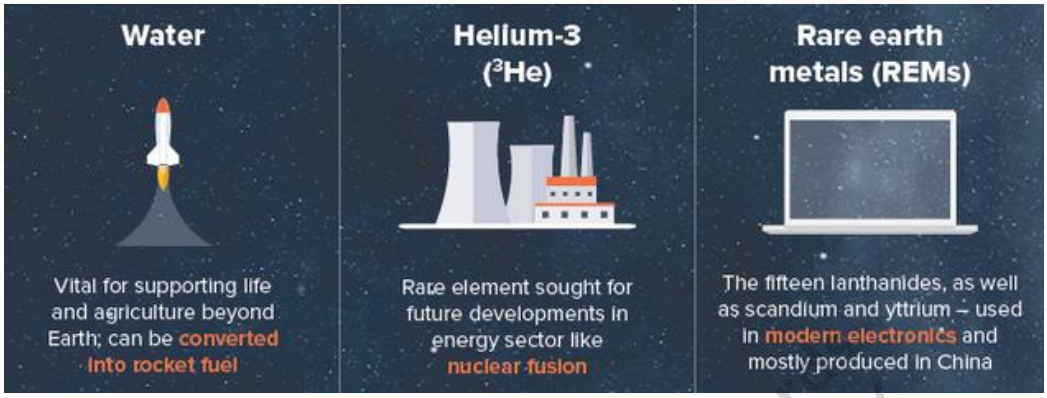
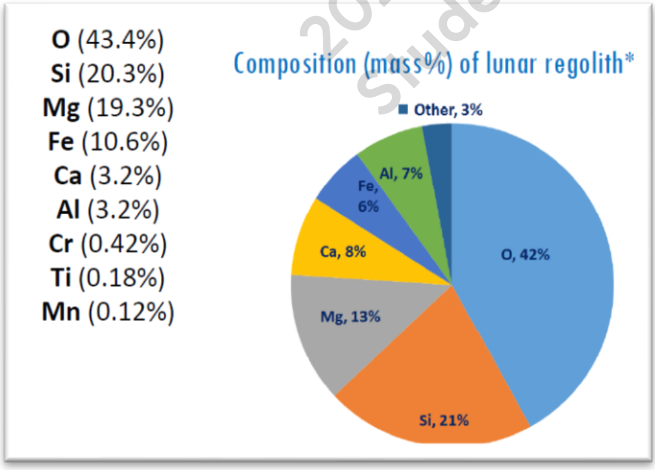
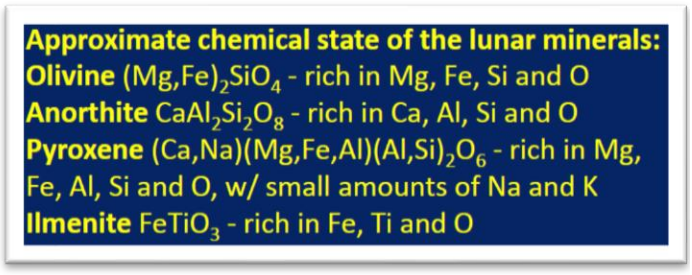


Figure 2: Three crucial lunar resources and their possible applications
(https://www.jpl.nasa.gov/infographics/infographic.view.php?id=11272)

A number of studies have confirmed that the Moon has water and helium 3 in abundance. Water will be necessary for any future mining activities, both for operations (rocket propellants) and for life support. Helium 3 can be used to produce safe, clean, and large quantities of energy, thereby transforming the future of energy generation on Earth.

Furthermore, the Moon has a number of other materials useful for space exploration as shown in Figure 3. "Most plans involve the collection of granular material, running it through some type of processing, e.g. thermal, chemical – the extraction of useful stuff and the discarding of the waste" says lunar scientist Paul Spudis. "Rare elements and isotopes (rare earths, thorium) may be accessed and mined."





(a) Composition of the Lunar Surface/Regolith **(b) Moon's Mineralogy**

Figure 3: Composition of the Lunar Surface/Regolith (Azad A. M. 2017)

II. How moon mining could work

Setting up feasible mining operations on the lunar surface is challenging due to the hostile environment such as a vacuum with extremes of heat and cold, hard radiation and presence of abrasive, angular dust grains. Self-sufficient and reliable robotics will be required to minimise the exposure of humans to the harsh environment.

"By using age-old techniques such as fractional distillation, coupled with newer techniques such as 3-D printing and advanced robotics, we will begin to learn how to mine and manufacture life support systems, human habitation, and the manufacture and sheltering of products off-planet on the Moon" says Spudis. For elements worth transporting back, reusable space crafts could be used as shown in Figure 4

Figure 4: How moon mining could work ((https://www.jpl.nasa.gov/infographics/infographic.view.php?id=11272))

III. Considerations for moon mining

As evident from Figure 5, it is highly unlikely that human activities will visibly change the appearance of the Moon. The bigger impact would be ethical concerns relating to the importance of the Moon in human culture and stakeholders in lunar heritage. While a lot more research is required to mine the lunar resources, international co-operation is needed for the betterment of mankind.

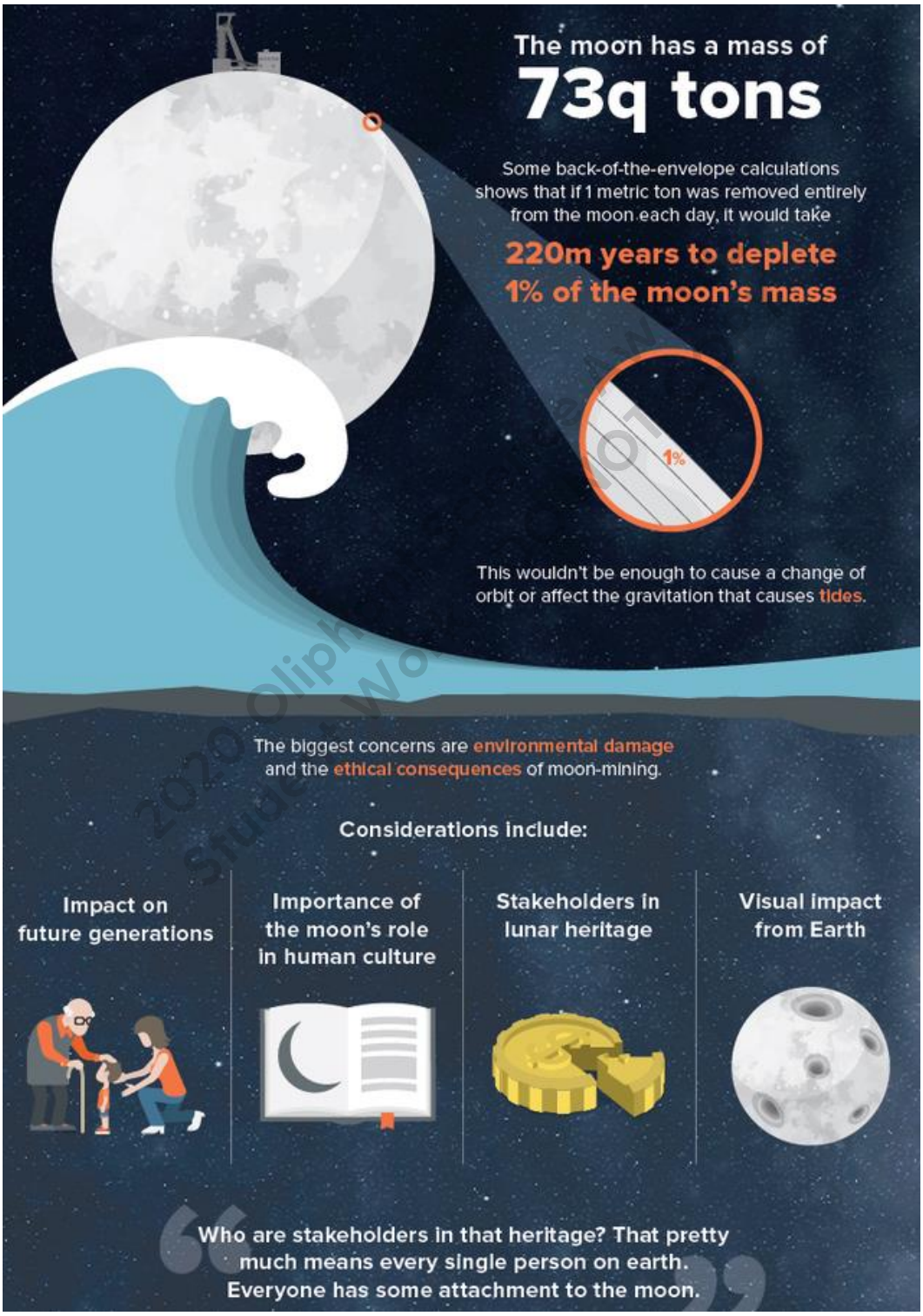
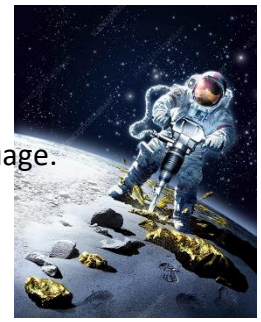


Figure 5: Mining impacts (https://www.jpl.nasa.gov/infographics/infographic.view.php?id=11272)

My Project – "Moon Miner"



For this project I have developed an educational game using Scratch Programming Language. The game is called **"Moon Miner".**

Game Details

This educational game is a fun way to learn about how Moon mining could work. It also gives information on lunar mineral composition and elements present on the Moon.

It's the year 2020, and the earth is facing energy crisis so Krish Space Agency (KSA) has decided to send a robot RoboMiner to extract useful minerals from the Moon. The RoboMiner has been specially designed to work on solar energy. It has a mining drill attached to it and a special device to detect the useful elements. Your job as an astronaut is to guide the RoboMiner to collect and identify various elements on lunar surface. But be aware you only have three attempts to correctly name and collect these elements and smash your way to victory in this fun easy to learn game!

Instructions

1. Once you press 'play' button you will see a rocket launch. Inside that rocket the Astronaut and the RoboMiner are waiting to land on the Moon.
2. Once the rocket lands on the moon, they will exit the rocket and go to the mining site. There the Astronaut will ask "What is your name". There will be a bubble given where you can answer.
3. The RoboMiner will have a mining drill which will always point to the mouse pointer. You will see four types of minerals with different elements inside them.
4. There will also be a score button to count up your points. As the RoboMiner, you will have to use the arrow keys and the drill to mine down and collect the elements.
5. When you click on a particular mineral, different elements will appear which you will need to identify one by one. The question will appear for every element on the screen: "What element am I?" you will get the bubble to correctly name the element and this time you only have 3 chances! Each correctly identified element gives you 10 points.
6. After you have mined all the elements, you will go to a screen that says congrats and that means it is the end of the game. Hooray☺!

Important keys to use while playing the game

- To start the game: left Click on the play button (will be displayed on the screen).
- To Move the RoboMiner: Arrow keys
- To mine (use mining drill): left Click
- To open Information about moon mining: Press I
- To open information about lunar Minerals: Press M

Note: This game can be played by children aged 10 years and above.

Potential Applications of this Project

- This game is an easy and fun way to learn about the how Moon mining could work. It also helps you to understand lunar mineral composition and elements present on the Moon. I am sure anyone who plays the game will enjoy it. This will also inspire the players to be creative and imagine other great possibilities and challenges associated with lunar exploration. This will help them understand why moon mining could be vital for Earth's future.

- My game shows a brilliant idea that could help us find rare resources on the Moon to ensure sustainability for future generations. The robot in the game has been specially designed to work on solar power with a special drill to find valuable elements on the surface of Moon. These elements can then either be processed on the Moon base or be send back to the Earth for various applications in energy sector.

Difficulty in Programming

I am the only one who knows how to code in my family so I had to do bit of research for some commands to design the program. Thanks to my coding classes at The Mawson Centre and the coding I learned in my school. At some points where I was a bit confused, the discussion with my parents helped me to format the game.

Reference List

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- Special thanks to my Teacher Ms Vira Wallis for sharing insights into Moon exploration and let us watch the BTN in class that helped me choose the topic for the project.

- My parents have helped me to edit the writing and formatting in this report.

Appendix
(Screenshots of the code in the program)