

LUNAR MISSION ONE

NUFFIELD RESERCH PROJECT

INTRODUCTION

What is Lunar Mission One?

Lunar Mission One is the most inspirational Moon project since the Apollo landings. Funded by the public it will perform world-leading science into the origin of the Moon and the planets, and it will leave a permanent archive of human life buried at the Moon's South Pole.¹



MY MAIN OBJECTIVES

Project title: Bioethical issues concerning the public and private archives.

I have chosen to examine the bioethics regarding the public and private which will be buried at the Moons South Pole. I had a brief idea about the archives during my first induction with the Nuffield research and the Lunar Mission One team; However after finding out more about the types of data which will be held within the archives I felt that there might be a lot of controversies and concerns regarding the storage of personal information hence why I want to access how problematic these concerns and controversies might be when the Lunar Mission One project goes ahead. Also I have chosen to look at the bioethics because I have a general interest in getting to know

¹ Lunar Mission One - Reach for the Moon. 2016. Lunar Mission One - Reach for the Moon what is Lunar Mission One | Lunar Mission One. <https://lunarmissionone.com/what-is-lunar-mission-one.html>

different perspectives especially those concerning scientific projects as I feel like there is a strong division between the views of different generations.

Along with my main objective: I aim to find out when and where the whole concept of bioethics originated, Why is it so vital for researchers so overcome any bioethical issues before conducting any research. As well as this I would like to find out where and when controversies surrounding DNA began, I will also look at previous bioethical issues regarding other projects which were similar to the lunar mission one project for e.g. other space projects, researches and experiments involving DNA like the cloning of dolly the sheep. Moreover I will also try to question or justify in some cases the reality of fear and concerns which the public might have about sending there DNA off to the moon.

ABSTRACT

The Lunar Archives

Lunar Mission One gives us an opportunity to put together a comprehensive statement of our existence in an am to create a record of life on earth; in the forms of archives which will be buried at the Moon's South Pole. There archives which are open to the whole public. They will digitally leave of the snap shot of our lives on the moon so they can be discovered by future generations.

There are two forms of archives. The public archive will contain a publicly accumulated and owned digital record of Life on Earth: a record of worldwide human history and civilisation to date, alongside a species database describing the biodiversity of animals and plants.²While the private archives will be a 'digital memory box' containing private digital information. The private archives can be individually purchased and can contain any personal information of one's choice e.g. family tree, massages, stories; you can even store you DNA either digitally or through a strand of hair.

Even though the idea of leaving a history of human life on the moon and securing a personal place in space seem very thrilling, there are bioethical

² Lunar Mission One - Reach for the Moon. 2016. Lunar Mission One - Reach for the Moon The Lunar Archives | Lunar Mission One: <https://lunarmissionone.com/lunar-mission-one/the-lunar-archives>.

considerations which need to be carefully assessed before allowing our genetic information to be potentially handed to an unknown future generation; if Dolly the sheep could be cloned on earth what are the chances that our genetic materials will be used for a similar purpose if discovered. Furthermore if DNA is so unique and vital part of our human life on earth is it morally and ethically acceptable for us to allow it to be preserved in an unknown conditions at the moon which we are still examining. Through a short report I aim to examine all possible bioethical considerations and concerns regarding the genetic information contained within the archives and hope to answer whether it is ethically and morally acceptable for our DNA to be sent to the moon.

METHODOLOGY

Most of my findings for this project were online research based as bioethics is such a controversial and complicated topic I needed a variations of insights even if I was looking at a very small topics; I had to compare and contrast a lot of information and findings before coming to any conclusions this was so I could avoid being subjective. I relied mostly on the Lunar Mission one website as it provided me with official and validated information. I also gathered some information through YouTube videos. Also I felt that news articles with bold headlines regarding DNA and Bioethics controversies were a main way the public engaged into these topics hence why I analysed a few news articles so see to what extent information had been manipulated or exaggerated.

I also used my Edexcel AS biology text book and my GCSE science text books to get me started on my research ; these books contained details about the need for scientific validations through conferences and journals before any research is published or fully recognised .The AS book had a lot of insights into DNA, its structures and importance . Also these books had detailed information on genetic engineering, cloning and DNA sequencing; especially the outcomes, process, ethics and the risks of the cloning of Dolly the sheep. While using information from the books and online articles I had to be very careful in picking out the relevant information which linked to my project objective.

Moreover I also asked my friends and people around me on their views on the archives and the Lunar Mission One in general so my research wasn't only online based and real issues and concerns were considered. Most importantly I used the feedback I received after my presentation as a guide line

to make amendments to the work I had previously done for this project and the new research I was hoping to do. After the feedback from one of the tutors I had to question some of my interpretation of the research I looked at as I wasn't aware of the full details and backgrounds of some of the research as they were difficult for someone of my level of understanding to interpret. As well as this there were gaps in my research and the conclusions I made were not fully backed up by evidence hence why I researched new topics and also added new findings to my older research.

As I had a lot of areas to research I divided my main objectives into four divisions so I could focus on different topics each week. These are the breakdown of the topics I focused on each week for a month.

Week 1

- Found out more about the Lunar Mission One project through the LM1 website , news articles and YouTube videos
- Began finding out what bioethics is, where and who sets the guidelines for bioethics.
- Began researching why DNA its conservation result to controversies.

Week 2

- Continued researching why DNA and its conservation create a lot of controversies
- Found out about previous issues and concerns the Lunar mission One Team had to deal with ; firstly I found this information out though the Lunar Mission One official website .Also after my presentation I asked one of the members of the Lunar Mission One team for more information regarding this subjects so I could add to my previous research.
- Started preparing Questions I could ask people for their views on bioethics, DNA and the archives which will contain the DNA and personal information.

Week 3

- Found out some views on the archives and people's concerns about sending DNA or personal information to the moon.
- Focused my research more around DNA.

- Looked at other a space programs which are similar to Lunar Mission One ant the way they have dealt with their bioethical issues.
- Checked up on the latest progress of the Mission to see if they have had any other problems they have had to overcome.
- Began writing up conclusions from my findings.

Week 4

- Continued summing up my conclusions and findings from relevant researches so I could include the information in my report.
- Added details to my previous research and researched some new topics in order to work on the recommendations I received during my feedback after the presentation.
- Started improving the structure of my report, and made corrections to the PowerPoint which I had used for my presentation.

RESULTS AND DISCUSSION

What is Bioethics?

Bioethics is a branch of 'applied ethics' In which experts from all fields such as philosophy ,science, law etc. come together to come up with rules and regulations for issues regarding the beginning and end of human life .Bioethics and ethical codes are used a as a means of protection of our basic human values such the rights to life and health, and the rightness or wrongness of certain developments in healthcare institutions, life technology, medicine, the health professions and about society's responsibility for the life and health of its members³.Bioethics is also a moral discernment as it relates to medical policy and practice⁴



³ Bioethical Issues. 2016. Bioethical Issues. Available at: <http://www.bioethics.org.au/Resources/Bioethical%20Issues.html>.

⁴ Wikipedia. 2016. Bioethics - Wikipedia, the free encyclopaedia: <https://en.wikipedia.org/wiki/Bioethics>.

Where and who sets the guidelines for bioethics and why is it so important to make bioethical considerations before carrying out any research?

Bioethics has existed only since the early 1960s. Due to the emergence of Organ transplantation, kidney dialysis there was a massive breakthrough of daunting ethical dilemmas which the general public, doctors and other professionals had to face. In order to set regulations to these procedures in its early years, the study of bioethical questions was undertaken by a handful of scholars whose academic home was traditional university departments of religion or philosophy⁵. However since the 1970's there has been an emergence of Institutions of Bioethics which means that main guidelines for bioethics are set by these institutions of bioethics. Other reasons why bioethical regulations have been taken into considerations in the recent era is because civilians are now more aware of their right and responsibility's, Many religious groups are beginning to question or oppose many procedures undertaken in the name of science e.g. Genetic engineering. Also due to the evolving technology more cases of exploitation, organ trafficking, elderly being mistreated in care homes are being revealed to the general public hence why in order to protect those who are vulnerable more individuals in the society are supporting the rules and regulations different bioethics institutions set out.

Bioethics are important and should be considered before carrying out any research or experiment because bioethics has an impact on every level of human community from the local nursing home to the huge international conferences on issues like the Human Genome⁶. As well as this through bioethics fundamental values of human lives are protected.

What is DNA?

DNA, or deoxyribonucleic acid, is the inherited material in humans and almost all other organisms.⁷ Nearly every cell in a person's body has the same DNA. Most DNA is located in the cell nucleus (where it is called nuclear DNA), but a small amount of DNA can also be found in the mitochondria (where it is

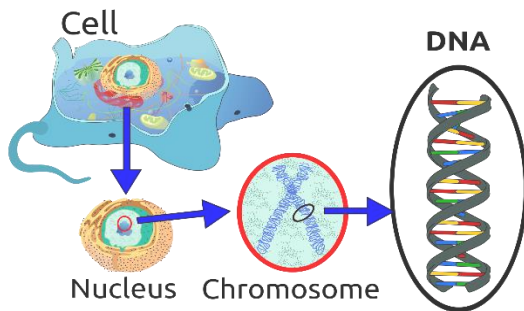
⁵ Bioethics Facts, information, pictures | Encyclopedia.com articles about bioethics. 2016. Bioethics Facts, information, pictures | Encyclopedia.com articles about bioethics.

<http://www.encyclopedia.com/topic/bioethics.aspx>.

⁶ What is Bioethics? 2016. What is Bioethics?: <https://www.practicalbioethics.org/what-is-bioethics>

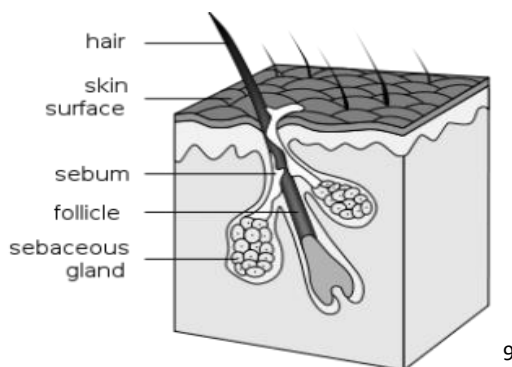
⁷ Ann Fullick, 2015. Edexcel AS/A Level Biology B Student Book 1 + Active book (Edexcel GCE Science 2015). Edition. Pearson Education Limited.

called mitochondrial DNA or (mtDNA). Every individual is likely to have genes which are unique to them as there are an estimated 20,000-25,000 different genes in the human genome, and it is not known how many different alleles of each gene exist.



How does our hair preserve DNA?

The hair consists of destroyed biological cells, and their DNA molecules are broken up into many segments. But they are preserved by a chemical called Keratin, and it is possible to electronically read the DNA segments and resequencing the code by computer.⁸



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What are other ways of preserving DNA?

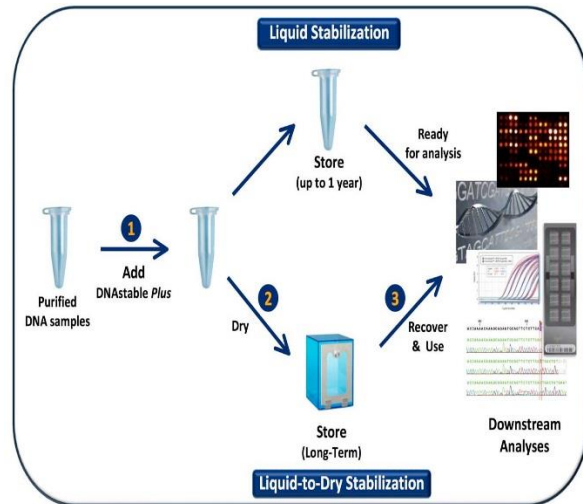
There are four temperature based strategies for long term DNA conservation. These are storage at: -20°C , -80°C , -196°C , Dried, at room temperature¹⁰; however preserving DNA through strands of hair will be the most beneficial way of storing genetic information in the archives as hair is very small and a thousand strands weigh a quarter of a gram . As temperature

⁸ Lunar Mission One - Reach for the Moon. 2016. Lunar Mission One - Reach for the Moon the Mission. : <https://lunarmissionone.com/the-mission>.

⁹ The Legal Genealogist. 2016. *DNA and the locks of hair* | *The Legal Genealogist*. :<http://www.legalgenealogist.com/2012/06/03/dna-and-the-locks-of-hair/>.

¹⁰ http://www.nbpgr.ernet.in/Portals/6/DMX/GENOMIC_RESOURCES/DNA%20storage%20methods-principles%20and%20protocols.pdf

based strategies of preserving DNA might be difficult as its will be hard to keep the environmental conditions under control on the moon.



What are the lunar archives and what will they contain?

There are two forms of archives of which one is fully open to the public out of charge. The public archive will contain a publicly accumulated and owned digital record of Life on Earth: a record of worldwide human history and civilisation to date, alongside a species database describing the biodiversity of animals and plants.¹¹ While the private archives will be a 'digital memory box' containing private digital information. The private archives can be individually purchased and can contain any personal information of one's choice e.g. family tree, messages, stories; you can even store you DNA either digitally or through a strand of hair.



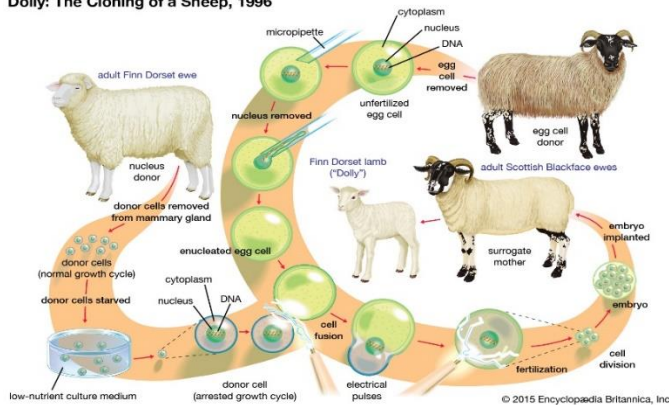
What are peoples concerns about the archives?

People had concerns that the DNA from the stands of hairs contained within the archive might be able to create a new identical body. With the current

¹¹ Lunar Mission One - Reach for the Moon. 2016. Lunar Mission One - Reach for the Moon the Lunar Archives | Lunar Mission One: <https://lunarmissionone.com/lunar-mission-one/the-lunar-archives>.

technology and facilities, it is unlikely that a 100% identical body can be created on the moon. Even though a lot of animals like Dolly the sheep have been cloned on earth, no identical human body has been created on earth as only plains of making synthetic lives have been made from digital DNA like the first self-replicating synthetic bacterial cell by scientists like Craig Venter have emerged in the recent years.

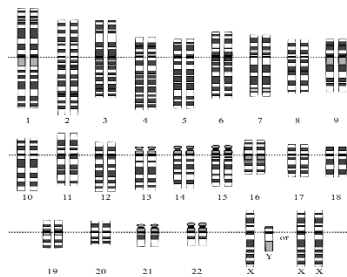
Dolly: The Cloning of a Sheep, 1996



People were worried that the genetic materials within the archives might be easily accessible. However, the Lunar mission one team have confirmed that the public and private archives life buried at the Moon's South Pole are secure and harder to access than most seed banks and other DNA preservation systems here on earth. Also individuals choose what they want to put in their archives; it is not compulsory that you have to send your genetic materials in the archives; you could simply send messages, pictures, photos, etc.

People questioned whether it was morally and ethically correct for us to preserve genetic material. However, we have been storing 20,000 genes and three billion base pairs within the human genome over the past 20 years, and there are also seed banks which preserve the genetic biodiversity of plants; these seed banks and the human genome project have had a very positive impact on human lives on earth as we have been able to study genetic diseases, we have been able to increase genetic variations, we have also been able to stop a lot of organisms from going extinct. Thus, even if some extreme religious groups might object, the idea of DNA conservation is supported by most religious and non-religious groups. As well as this, there are other space projects such as voices of Humanity that will send data,

messages and DNA into space using laser propelled spacecraft's which have gained quite a lot of support so it's very unlikely that many people will oppose to the idea of sending information about life on earth and also DNA to the moon through the public and private archives



CONCLUSIONS

From my project I have found out that bioethics need to be considered because they act as guidelines and restrictions stopping DNA and genetic information from being manipulated too much, they also protect the vulnerable from being exploited.

Furthermore there were a lot of bioethical concerns that people had regarding the archives; however due to past projects like the cloning of dolly the sheep , other space missions, human Genome project, Seed Banks and genetic engineering it is completely under the bioethical boundary's for the archives to act as DNA preservers while at the moon. As well as this this projects also protects ones right to consent, confidentiality and privacy as it is not compulsory for Individuals to include there biological data on the private archives also the information on the archives will only be looked at if discovered in the future .Therefore I conclude that it is morally and ethically acceptable for genetic material to be sent to the moon through the archives.

EVALUATION

Overall being involved in the Lunar Mission One project has not only opened my eyes to a new world of science but it has also taught me the importance of good discipline and dedication. The Nuffield project has taught me a lot of vital research, communication and presentation skills which I believe will help me throughout life .Even though I was nervous to begin with as I got on with the project I felt that every bit of work I produced was highly appreciated; the

support and appreciation I received from the Nuffield and Lunar Mission One team has made me want to be a part of more research project of this kind.

Also working on this project with little but valuable guidance has made me more confident in the work I do as I have learnt that if you're enjoying the task at hand there's no right or wrong way of expressing the things you've learnt. In projects which I have previously been part of I have lost interest in them very quickly however being part of this project has kept me constantly engaged as I am always wanting to know more after every bit of research for e.g. To begin with I had only had basic idea about the role of DNA and bioethics but through the course of this project I have found out how much of a big role they play in our daily lives. Though this project I have had an opportunity find out not only about the Lunar Mission One but also other space mission which are currently taken place or have taken place in the past.

Even though I have had an overall positive input towards this project there were some aspects which I struggled with. One of my weaknesses were that at the beginning of this project I struggled to narrow down the topic of bioethics and relate it to the Lunar Mission One Project hence why to begin with my research wasn't very concentrated and had a very wide focus. This meant that I wasn't able to make clear conclusions which I could begin writing about in my report.

One another weakness of my input to his project is that my time management skills weren't as good as I had anticipated them to be as I wasn't able to efficiently follow my weekly research plan which I had scheduled. This was due unplanned family visits during the summer, results stress, other responsibilities and duties. This has meant that during some weeks I wasn't able to research certain topic at the same depth as others; hence why there were gaps in some of my research.

Also I felt that I didn't have enough variations in the resources I used for my research, I used mostly online sources. Although the online resources were easily assessable some of the information they contained seemed overly exaggerated or manipulated; in some cases some terminology and the general language used in some articles were too complex for me to interpret. As well as this due to lack of time, even though I had begun to plan some questions for

a questionnaire which I was hoping to use as a source of primary evidence I wasn't able to complete the questionnaire.

If I were to continue with this project I would begin by finishing off my questionnaire so I could include some primary evidence as a source of research in my conclusions. I would also do an in-depth research on the topics I choose for my project objectives. After finishing researching bioethics I would focus more on the chemistry side of the Lunar Mission One project like: what chemicals should the archives be made of in order for them to be suitable for storing DNA in the moons atmosphere for a long period of time? What chemicals are contained within strands of hair that makes it good for DNA preservation? Do the strand of hair need to be preserved within any chemicals while there in the archives?

If I had an opportunity to carry out a project like this in the future, I would like to make a better use of the resources which are available to me , seek more feedback from my mentors in order to make sure I was on track throughout the whole project, I would also manage my time better by staying on task each week without letting any other external factors affect my work ethic. I would use both primary and secondary resources to back my conclusions.

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