Introduction:

When I got the chance to create a long-term project on a subject that I have always had an interest on, I was lucky to know what I wanted to do. My personal interest was on conspiracy theories and the unknowns of space. I have always had an interest with space, mainly the Milky Way Galaxy since I was younger and as I grew older space started to become more and more intriguing. So, when I had a chance, I wanted to explore theories related to space. Around the beginning of this project, I was watching the news with my parents and a scientific discovery from NASA was projected. As I watched the professor in the news talk about spacetime and wormholes I realized how easily the basics could be understood and how interesting the manipulation of space and time actually was. With the personal project I wanted to expand my knowledge specifically in time travel and with my product I wanted to be able to explain time travel as simply as that professor did.

These personal interests then led to my personal project goal which is to introduce people to the physics of time travel with movies that most of them have heard of. This way I will be able capture the attention of many movies, conspiracy and physics lovers, or in general people who want to learn about one of the most asked questions; is time travel possible?

Planning:

Learning goal:

My learning goal for this project is to learn about the theoretical physics behind the idea of time travel. Within this topic, I want to understand areas of; Einstein's general and special relativity, spacetime, the speed of light, paradox theories, black holes and what lies behind their horizon, the light speed barrier, wormholes and the consequences of time travel and under which conditions they are possible. This goal is highly challenging since understanding the research that I will be reading and watching will be hard since I am only a beginner in this context. Which is why I have planned to do overall research and then deepen my understandings.

With my learning I want to be able to create a short and simple video that will capture the audience's attention. This video will help me achieve my final goal of being able to teach normal people the theory behind time travel in a simple manner.

Global Context:

My goal supports my chosen global context: scientific and technical innovation, since my learning and product goal will help introduce people to a developing theory within physics which is one of the mysteries the universe. The global context that I will be focusing on with this product and project itself is technological and scientific innovation. As technology has shown great improvements over the years; access to space has become easier. Space is one of the most unknown factors of science, specifically physics itself. Time itself is also quite an interesting concept and imagination of humans brought in the idea of Time Travel. Many movies and books, like the ones I'm handling, have been created that considers the idea of time travel. Yet many people do not know the science and the physics behind all of this. As science and technology grew research on the theory of time travel increased as well to the point some truths were found. With my project and my chosen global context, I aim to make use of this innovative research and educate people on the theory of time travel.

Success Criteria:

To achieve my product, a short and simple video that is educative and intriguing I will have to create an original and high-quality piece of work. In order to do this, I will have to focus on the content presented within the video and the aesthetics of the video. The video should have colorful and action-packed scenes that will capture the attention of the audience without directing it away from the knowledge within the content. To achieve this I will follow my success criteria as given below.

Success Criteria	Lesser Than Expected	Meeting Expectations	Better Than Expected
Product is created on time	Product is created during the week of January 16 or the days before	Product is created by the end of December	Product is created by the end of November/ beginning of December

The numbers are citations from the bibliography

Product is 5 minutes	The video is above 5 minutes and is not concise	The video is around 5 minutes or a little above like 30 seconds or a minute	The video is exactly 5 minutes or 15-30 seconds shorter
The video is simple and clear	The video is jumbled, the information conveyed is hard to comprehend and make sense of	The video explains the basics of time travel in a clear and understandable way	The video clearly explains every important bit of knowledge to the audience and is concise and not boring
The video is visually pleasing	The video is dull, has no animations or pull factors like colors, audios, movie scenes or etc.	The video has ample pull factors like different animations, edits, scenes from movies, voiceovers and etc.	The video has many pull factors and is professionally edited with scenes from movies, transitions, scenes from movies and etc.
All relevant information is conveyed	The video can only convey the basics and not the details of time travel	The video clearly conveys the basics and some of the details of time travel	The video conveys the basics and all-important details of time travel
I am able to explain and understand the material without reading	I am not able to speak about this topic without my notes or information	I am able to speak about the basics of my research without my notes	I am able to hold a conversation and answer multiple sorts of questions considering my topic
Audience satisfaction is secured	The audience gets bored of my video and my topic easily and I am not able to explain my research	Most part of the audience is attracted to my topic and stays for the full of the presentation, engaged	All of the audience is engaged with my presentation and topic and they ask me further questions and try understand my topic

Action Plan:

I have planned to create this product, yet I need to manage myself and my time in order to make the most of the time given to me. For this I have created a detailed action plan that gives me specific dates and descriptions of my actions to manage my time. I have planned this action plan from the beginning and have been following it ever since. My action plan is detailed and organized according to the set-out due date, to help me navigate easily through it. I have all the steps laid out that I will follow to achieve the perfect product and complete my report on time.

Action Plan					
Action	**Priority**	**Status**	**Start**	**End**	**Notes**
Brainstorm about the topic	Medium	Completed	July 24 2021	July 26 2021	
Start the find research sources for the topic:	High	Completed	August 1 2021	November 1 2021	
Start the actual research process:	High	Completed	August 4 2021	November 1 2021	

The numbers are citations from the bibliography

Start the movies:	High	Completed	September 25 2021	October 16 2021	
Bring all the information together in a concise presentation (PowerPoint):	High	Completed	October 17 2021	October 18 2021	
Start the video for the final product:	High	Completed	October 18 2021 – October 19 2021	October 20 2021	
Meeting with the supervisor:	Medium	Completed	October 26 2021	October 28 2021	
Second meeting with supervisor:	Medium	Completed	November 11 2021	November 22 2021	I did not get feedback until I finalised my product and got it on 17/02/2022
Add notes to the video:	Medium	Completed	December 5 2021	Januray 12 2022	
Draw the animations:	Medium	Completed	December 20 2021	January 6 2022	
Hand in the final product:	High	Completed	January 16 2022	January 16 2022	
Work on criteria B report:	High	Partially completed	January 16 2022	February 4 2022	
Third official meeting with supervisor:	Medium	Completed	February 17 2022	February 17 2022	
Present to a classmate or teacher for feedback:	High	Completed	February 4 2022	February 17 2022	I presented the video to my supervisor before the mid-term break and got feedback the week after
Add the feedback to my video and polish it:	High	Completed	February 18 2022	February 19 2022	
Practice my presentation methods:	Medium	Completed	February 18 2022	March 8 2022	
Start the booth:	High	Completed	March 3 2022	March 8 2022	
Have the final presentation:	High	Competed	March 8 2022	March 8 2022	
Start the final reflection and hand in a draft/ skeleton of it for feedback:	High	Completed	March 9 2022	March 12 2022	

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Get feedback on my skeleton/ first draft of my final report.	High	Not completed			Due to the fact that the school had a break right after our exhibition I wrote the final report and submitted without feedback for criteria c.
Work on the report and get in a more advanced and revised draft (second draft in my case):	High	Completed	March 12 2022	March 18 2022	
Check-in meeting with my supervisor	Medium	Not completed			Due to break I was not able to have a meeting with my supervisor.
Finalize the whole report	High	Completed	March 18 2022	March 19 2022	Hand-in date is March 20 2022

To conclude, I have finished my planning stage with my learning goal, success criteria and detailed action plan that will get me through the whole process. Now, I will start on the actual procedure of creating my product.

Applying Skills:

Research:

After completing my planning, I started working on achieving my goals. My first goal was my learning goal which is "I want to learn about the theoretical physics behind the idea of time travel. Within this topic, I also want to understand areas of; Einstein's general and special relativity, spacetime, the speed of light, paradox theories, black holes and what lies behind their horizon line, the light speed barrier, wormholes and the consequences of time travel and under which conditions they are possible. I want to be able to have all this knowledge and then assess the three movies that I have chosen from the aspect of physics by the end of this project.". To achieve this goal I used my communication, research, self-management and thinking skills.

I used my research the most for this goal. I researched and accessed many secondary sources such as books, videos and articles online and in hand. I was only able to use secondary sources due to the topic that I had chosen. I did not have any professor or teacher that I could really talk to and get an interview in terms of time travel since it would require an expert. This is why I referred to secondary sources directly from those experts which were easier to access.

I collected data from two books before watching videos, interviews or reading articles. Here I also used my critical thinking skills to identify challenges and create a solution. The challenge that I was facing was that the research was too broad and complex for me to understand in one go. So, at first I decided to research generally and build-up my knowledge and then interpret specific sources explaining the physics behind the movies themselves. So, the two books that I used were Time Travel and Warp Drives from Allen Everett and Thomas Roman (2) and The Universe in a Nutshell by Stephen Hawking (4).

After researching these two books I gained a more deepened knowledge on time travel, wormholes, warp drives (travelling at speeds close to the speed of light) and etc. I merged these two books to make connections and further my understanding.

For example, *"But also according to Einstein's relativity we cannot know if we are at a stand-still or moving at a constant speed unless someone does not observe from the outside (Stephen Hawking). For example, if there was a spaceship moving away from the Earth at a speed close to light speed, it would eventually have to take a 'U' turn, in this movement the spaceship has to accelerate. This will*

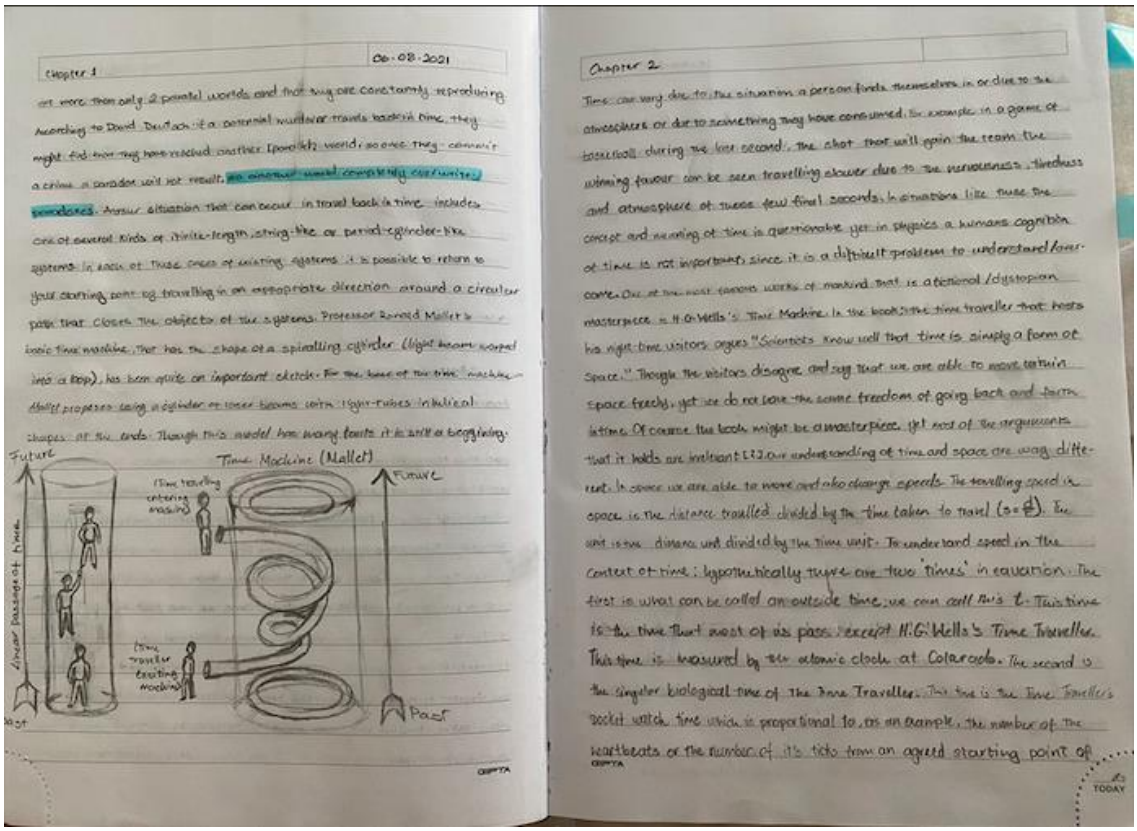
The numbers are citations from the bibliography

tell us if the spaceship is moving away from the Earth or if the Earth is moving away from the spaceship (Allen Everett and Thomas Roman).”

This piece of interpretation was taken from my process journal. I used both of the books to explain how a person is not able to understand if they are standing still or moving in a straight line at constant speed unless there is no outside observer.

Of course, these are not the only sources I used. I then further used my research skills to select appropriate sources that were specifically on the physics behind the 3 movies that I had chosen. These sources were interviews from Kip Thorne, the physicist behind Interstellar, 2 videos from a physics professor who separately talked about Tenet and Interstellar, and another video on the wormhole travel in Contact.
Links: (Convert to MLA8)
Contact: 3
Tenet: 5,6
Interstellar: 1,7,8

Whilst investigating all these sources I took notes. I first of all took all my scrambled thoughts and important passages directly from the books and videos. I wrote them down is my process journal as shown below.



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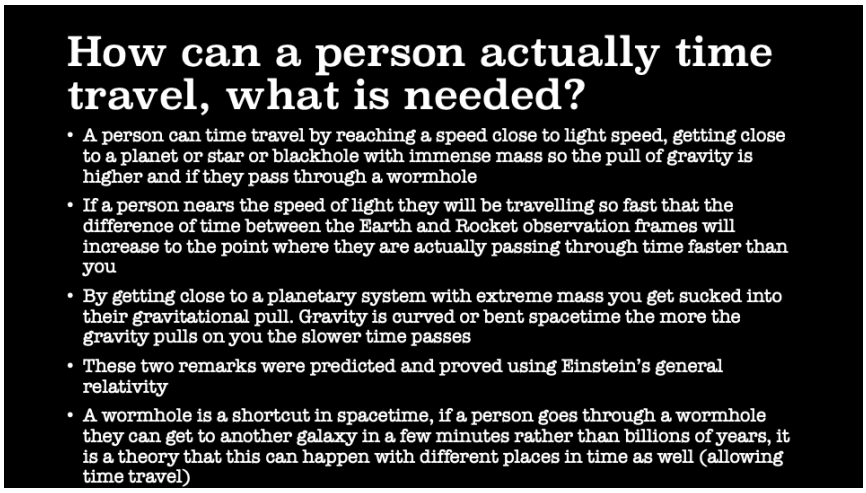
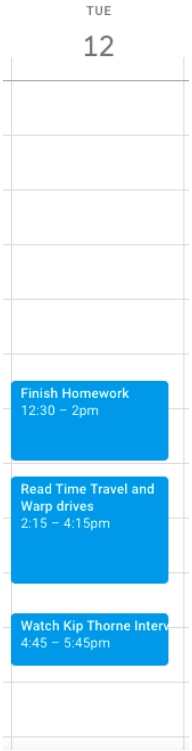
This contributes to my communication skills for taking effective notes on what I read for comprehension of my topic. However, these notes as it can be seen were quite confusing and complex. Because of this reason I read all my notes after finalizing my research and paraphrased/ condensed them into a simpler format to keep track of the information. This contributed to my self-management and particularly organizing my information in a clear manner. All these scrambled notes turned into bullet points and questions in a PowerPoint as shown below.





Whilst doing my research which I spent a lot of time on because I first had to develop my overall knowledge and then focus on the movies and deepen my knowledge in specific areas. This was gruesome and hard work which was why I had to use my self-management skills to practice and focus concentration. I planned out my day using a planner and after school I gave myself some time to do my school related homework and then work on my research. Between time periods I gave myself 15-30 minutes of break to not overbore myself and to be able to continue on working. As shown on the left, this was 12/10/2021, this was one of planning for one day. I used this hack to focus on working for a few hours and then calming down by taking a break.

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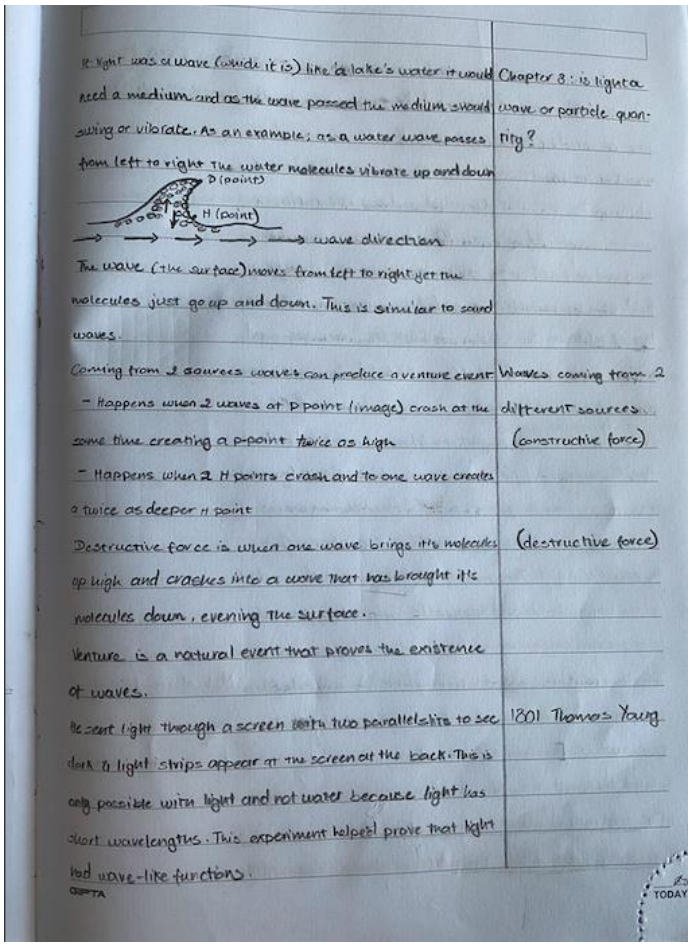
In addition to my research, communication and self-management skills I also used my thinking skills. I mainly used my thinking skills to understand the information that I presented to myself with the research. I had times where I could not understand what the books, videos or articles were talking about because of the difference levels of information I was being presented. To overcome this I used different types of models. I used pictures and animations to understand what was being presented to me. In addition to this used my knowledge from previous classes such as math and physics to further help me understand the information. For example, when I used my knowledge of ocean waves from previous science classes to draw a model and explain how transverse and longitudinal waves worked so I could further understand how light was both a particle and a wave.



Product:

After finalizing my research, I moved on to my product. My product goal is: " A concise yet understandable short video of 5 minutes that will bring together critical scenes from the movies and animations from my own making. This video will explain the physics of time travel and speeds close to light speed behind Interstellar, Contact and Tenet. I should be able to produce a video that will be simple enough for people, with a close-to-no understanding of physics can understand. I will stop the video sometimes to explain parts myself, during these transitions I should be smooth and my speaking itself should fit in easily with the video itself.". To achieve my product goal I used my communication, research, self -management and thinking skills once again.

With my communication skills I mainly used this to talk to my supervisor on how to create the product. After many meetings we decided on some simple ideas and guidelines that I should follow for the video. Like a checklist, as shown below.

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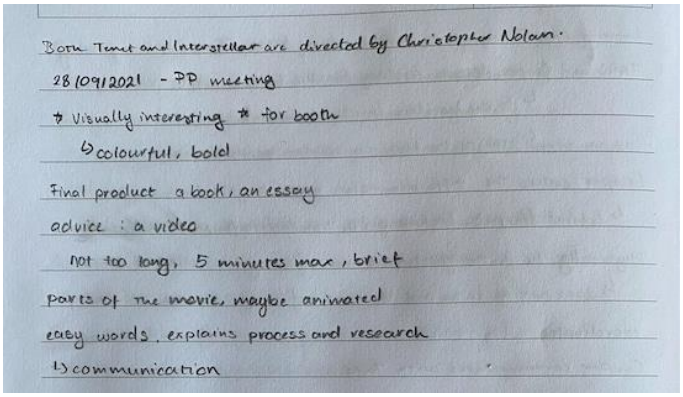
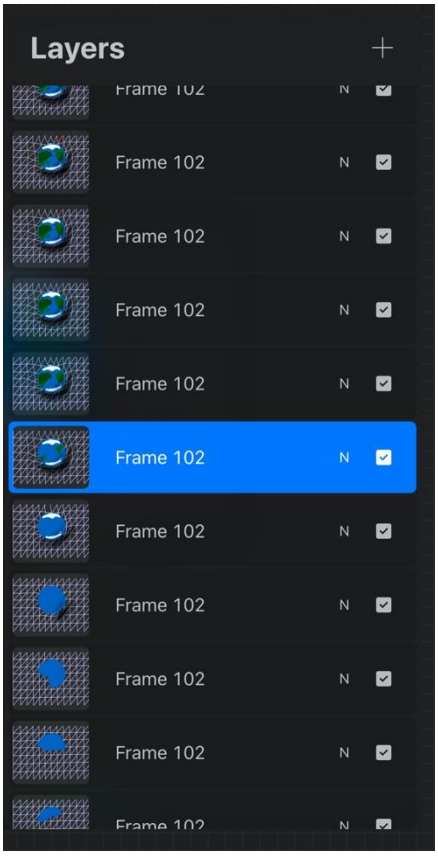

Both Tenet and Interstellar are directed by Christopher Nolan.
28/09/2021 - PP meeting
* Visually interesting * for booth
↳ colourful, bold
Final product a book, an essay
advice : a video
not too long, 5 minutes max, brief
parts of the movie, maybe animated
easy words, explains process and research
↳ communication

Another communication skill I used was different types of speech. For my product I created a script. Some parts of the script would be said in the video and the others would be said in-person during the presentation. These different types of speech and verbal communication, especially the interactive one, will help me keep the attention of the audience during the video without boring them by just giving them a documentary to watch.
Along with the script I used my organization, self-management skills. To separate the types of speeches I used different colors; specifically white and blue. This helped me organize what I had to say in the video and what I had to say in the presentation, without me getting confused. For example, the script from Contact. The blue is said in the video and the white is said in person.

3) Contact
- Contact, directed by Robert Zemeckis, explores the consequences after humans receiving outer space contact.
- This contact that comes from the Vega Galaxy in the movie transmits blueprints of a transport vehicle
- The machine, which accompanies only one driver, is then built and launched in order to reach outer galaxies
- Dr. Ellie, the protagonist who is the driver travels through wormholes as shown in this scene
- As it is expressed in the movie, visually the vehicle had not disappeared, yet it only fell through the sky to the ground in a matter of seconds
- Yet in this scene 18 hours of recording, the time of travel expressed by Dr. Ellie, is discovered,
- This shows that Dr. Ellie travelled 18 hours through time whilst the Earth only travelled a few seconds. Proving that Dr. Ellie's temporal speed was much faster than Earth's. So, Ellie personal time is now 18 hours ahead of Earth's time.
- Ellie travelled 18 hours through time whilst only a few seconds passed on Earth because the universe around Ellie moved through space faster causing the universe's relativistic mass to increase and the time of the universe to slow down compared to Ellie's. Which is possible unlike Tenet.

The numbers are citations from the bibliography



Along with this I used a variety of platforms and media to present my information. My main product was my video but next to that I also had a short animation clip that I used to explain spacetime and how gravity was created through the manipulation of spacetime. As shown on the left, those are some of the frames of my animation.

My research for my product goal mainly consisted on how to edit videos and how to make animations. I used procreate to make animations for this I had to understand how to use frames and layers and how to manipulate them. I searched up tutorials and learnt how to create animations which was by drawing each small movement by hand in different frames. I used an app called video star for my video. It was simpler than After Effects yet had better effects and quality than iMovie. Which is why these two software made my job easier and helped me achieve my product.

For my self-management one of the main skills I used was overcoming failure and showing resilience. This was mainly because when I was creating my product the first product I created was a short 5 minute video, that had scenes from the movie and my own voice speaking in the background like a documentary, and an animation on spacetime. But this video was not original. I had taken the animation from someone else, even though I did give credit it was still not original and my editing skills were not good enough so the video looked as if it were lagging in some frames. Because of this failed attempt I had to take that disappointment and use that to change my product. After that I changed my product into a new video with an animation that I made by myself and an interactive presentation type of video. My thinking skills that were involved mainly helped me after the failed product. I used my old video and took some scenes from it and then I used that base to design and think of improvements. Without any brainstorming I knew that I had to create my own original animation. For this I used my skills and knowledge from art, where I have drawn comic strips before, to create layers and frames and draw my animation by hand without struggling on aesthetics as much. An example from my animation that was drawn by hand:

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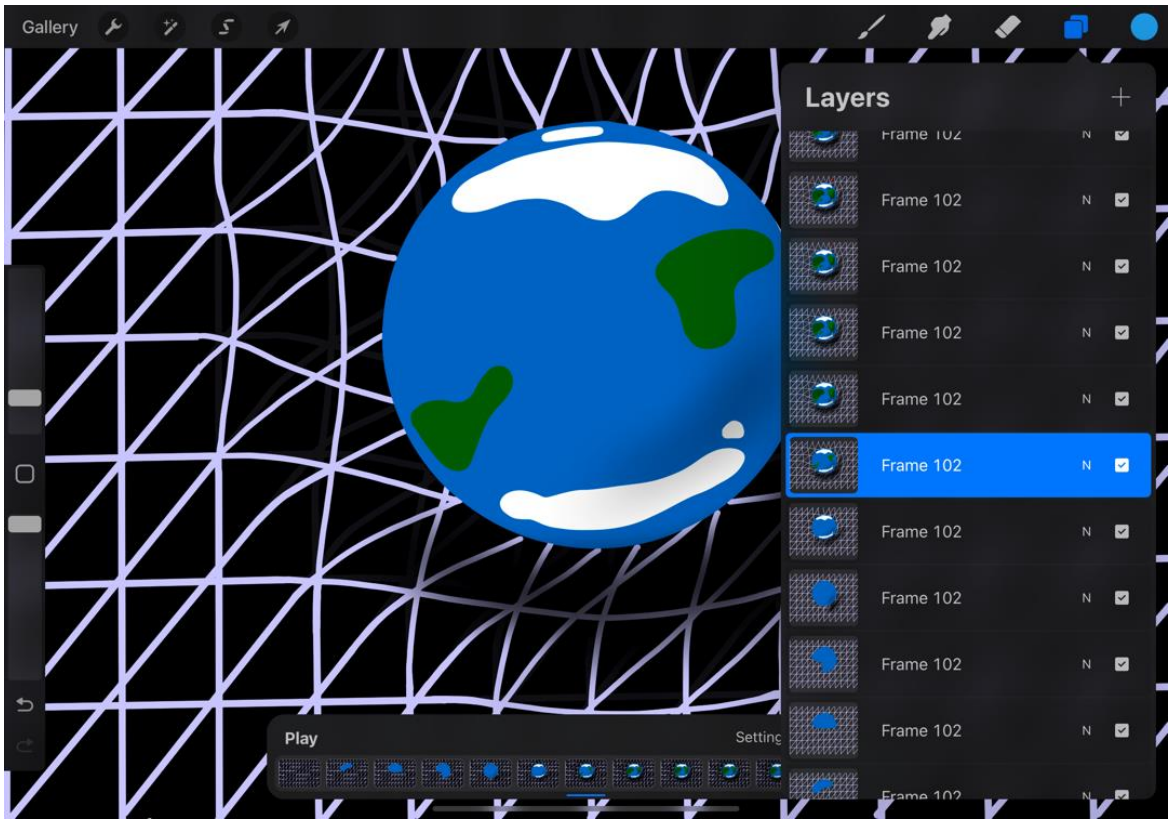

Along with this I also had to think of a way to improve my editing. So, I decided that instead of going for complex transitions from one frame to another I would simply use a blackout effect. This made my transitions consistent, so the video looked cleaner and clearer.

Reflecting

This project has taken me through quite a long and tiring journey. It started during the beginning of summer when I first started brainstorming about my ideas and will probably continue on to develop my knowledge years into the future. This project helped me improve many of my approaches to learner skills and opened a gate for one of the biggest mysteries of the universe. The universe and space and time itself. Time travel is only a small part of the theories of the universe and there many other interesting problems and theories going around with the research of the universe for example, parallel worlds, different types of stars, etc.

The journey of the research itself developed my interest and concentration skills the most. Of course, I also improved other skills like source and content analysis but what really developed was my interest to the topic of space and my concentration skills which allowed me to focus on my research and finish the product on time. I think the most important gain I got from this experience was definitely the interest. The increasing enjoyment I felt when I was researching and reading about time travel is what kept me going with this hard project and it also increased the amount of my questions. This even led to me purchasing more books and magazines and watching more documentaries like Carl Sagan's Cosmos which explains many aspects of space and the universe and helps expand my knowledge.

This project immensely developed my knowledge on this topic. It improved my inquiry and knowledge attributes. The more I learnt the more questions came up that I had to think about. I always thought that time travel was a piece of fiction created by dystopian writers. But the first fact that I learnt as a researcher and learner was that time travel could actually be possible with certain conditions. The fact that I had always known time travel as a piece of fiction and the revelation that it was truly shocked me and aroused and interest to learn more about this theory, within me. As I learnt more about time travel and the conditions it could work underneath, I also discovered that time travel

The numbers are citations from the bibliography

was not necessarily huge jumps between timelines but rather time manipulation. For example, as the relativistic mass (mass related to the speed of an object) of a person increases (as velocity increases) their mass becomes infinite and thus time passes slow for them, but it continues to pass normally for the people on Earth. This will cause the person, once they come back to Earth, to see a world that has aged and passed through many ages, basically for them they are now in the future. But they cannot go back to the past, which is why time travel is more like time manipulation and changing one's personal time. This is one of the many details and information that I learnt through this process. One the things I haven't learnt much about and would like the research more, especially after watching Interstellar, are blackholes. How are they formed are there certain conditions they need to be created, what are the theories of the idea of space beyond the horizon line and etc. This project has really expanded my horizon of knowledge on space and time and created even more inquiries for me to search after.

In general, it was quite a fun journey with many ups and downs. There were times at which I wanted to pick an easier topic for example, when I was reading Time Travel and Warp Drives it was really difficult at times to understand everything that was being said and I got confused with most of the mathematical aspects. But this project also helped develop my resilience, so I continued with this research at the end of the day. In the end, I believe everything paid off, I managed to create a good video with clear edits and a decent animation. I am quite proud of myself for choosing this challenge and not giving up on my research and project during the middle of it.

The product that I created was a video around 7 minutes long with an animation and visuals from the movie. To assess this product, and to see if I have managed to achieve my product goal, I will compare the final with the success criteria I did during my planning stage. Here is my success criteria:

Success Criteria	Lesser Than Expected	Meeting Expectations	Better Than Expected	Has the product met the criteria?
Product is created on time	Product is created during the week of January 16 or the days before	Product is created by the end of December	Product is created by the end of November/ beginning of December	Product was created on time during meeting expectations at the end of December only the animations were added later.
Product is 5 minutes	The video is above 5 minutes and is not concise	The video is around 5 minutes or a little above like 30 seconds or a minute	The video is exactly 5 minutes or 15-30 seconds shorter	The product is 6 minutes long so it is within meeting expectations. This was because I added an extra part for spacetime at the beginning for further explanation of my chosen topic.
The video is simple and clear	The video is jumbled, the information conveyed is hard to comprehend	The video explains the basics of time travel in a clear and understandable way	The video clearly explains every important bit of knowledge to the audience	The video and the presentation were concise and I made sure to emphasize important parts

The numbers are citations from the bibliography

	and make sense of		and is concise and not boring	to make sure the audience understood the topic. In my feedback many of the audience mentioned that it was a well rehearsed presentation and the I was inclusive with the topic.
The video is visually pleasing	The video is dull, has no animations or pull factors like colors, audios, movie scenes or etc.	The video has ample pull factors like different animations, edits, scenes from movies, voiceovers and etc.	The video has many pull factors and is professionally edited with scenes from movies, transitions, scenes from movies and etc.	The video has animations, coming from the feedback form my supervisor and my parents the video transitions are edited visually pleasingly and the scenes from movies were used.
All relevant information is conveyed	The video can only convey the basics and not the details of time travel	The video clearly conveys the basics and some of the details of time travel	The video conveys the basics and all-important details of time travel	I made a questionnaire after the video and presentation. The audience who were listening intently managed to score 5/5 or 4/5 mainly. There were a few lower scores like 2/5 but those were during my first tries at presenting so I wasn't as confident at presenting but over time the results increased by a lot.
I am able to explain and	I am not able to speak about this	I am able to speak about the basics of	I am able to hold a	During the presentation I

The numbers are citations from the bibliography

understand the material without reading	topic without my notes or information	my research without my notes	conversation and answer multiple sorts of questions considering my topic	was able to add extra information as I saw fit and then sometimes take away information or make it simpler to understand. This was because sometimes I presented to adults and then grade 5 students. I was also able to answer all the questions without referring to my notes since I had read over them and learnt them fully.
Audience satisfaction is secured	The audience gets bored of my video and my topic easily and I am not able to explain my research	Most part of the audience is attracted to my topic and stays for the full of the presentation, engaged	All of the audience is engaged with my presentation and topic and they ask me further questions and try understand my topic	All the audience that I had stood and watched my presentation fully and on the feedback sheets one of the questions asked "Did you find the video engaging" all of them put a yes.

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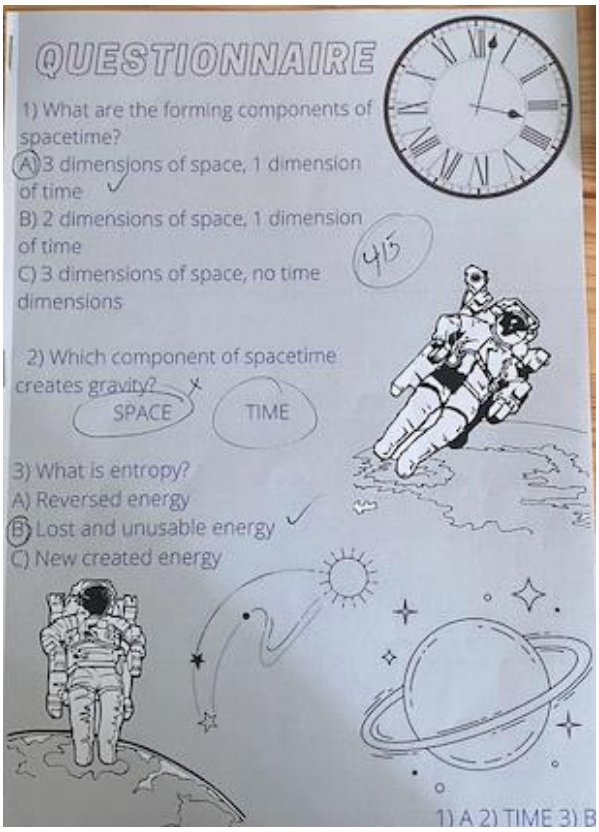
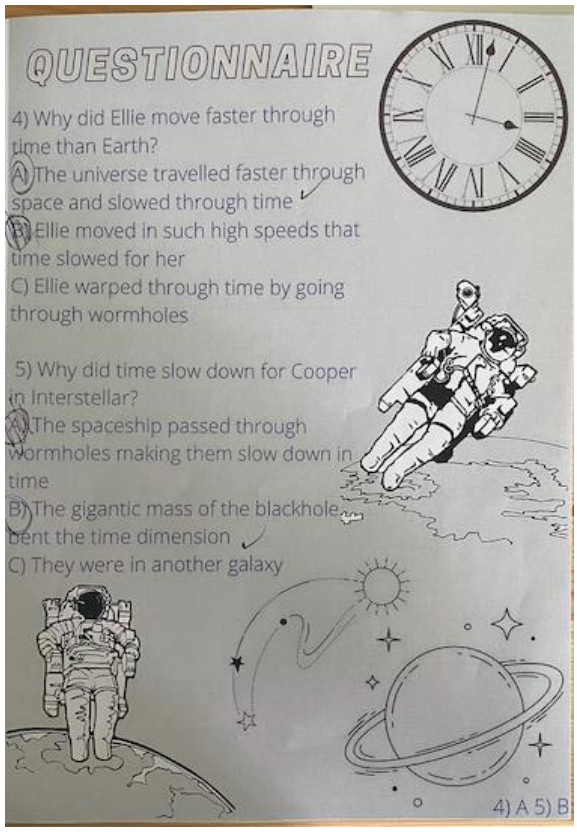
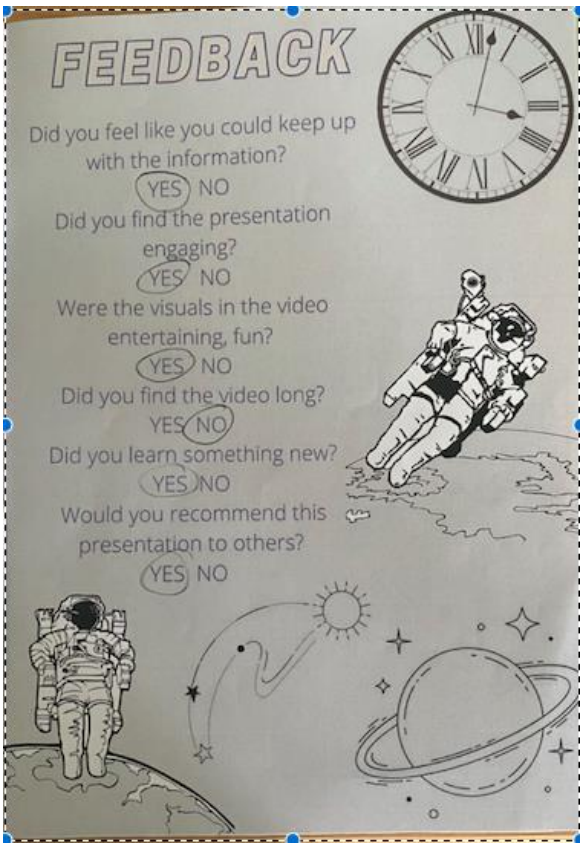
Examples filled questionnaire and feedback sheet:







Considering the outcome of the product analyzed with the success criteria I could say that my video was successful. It was engaging towards the audience and my presentation of the video was efficient. Along with these points I would have liked to improve the animation of my spacetime. One of my friends mentioned that the animation was a bit slow and could have matched the information presented more successfully if it was faster. That is the main part that I would like to improve in my video and also maybe improve the audio quality because during some parts the video the voices could not be heard by the audience. Overall, I would say that this project was great and valuable learning experience for me that gave me an opportunity to research and further develop my knowledge in an area of my interest and liking. This was a fun experience for me and the final product, my video, even though it was hard to make at times it came out meeting and, in some criteria, exceeding my expectations, and this will always make me jubilant and proud. I am grateful to have had such an experience and will further on continue researching my interest in this field even in the years to come.

The numbers are citations from the bibliography