Design Documentation

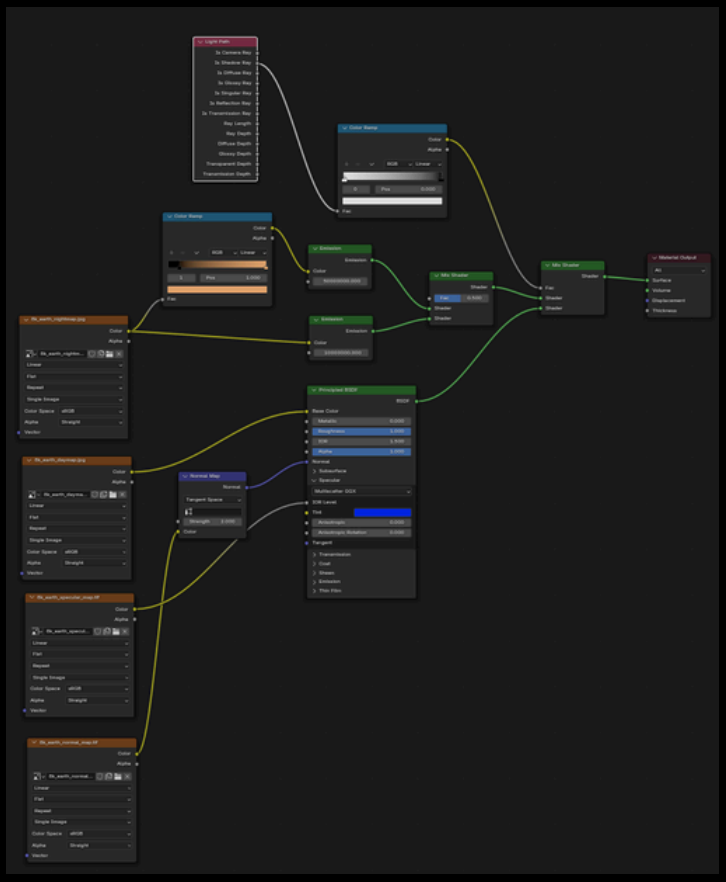
By Evelyn Moore

Introduction

This document will outline and explain the design choices behind the “Seasons of the Solar System” video. The aim of the project was to create an engaging and educational animation that teaches teenagers about the weather patterns and seasons on each of the planets of the solar system, and expands on knowledge that adults might already have.

Topic

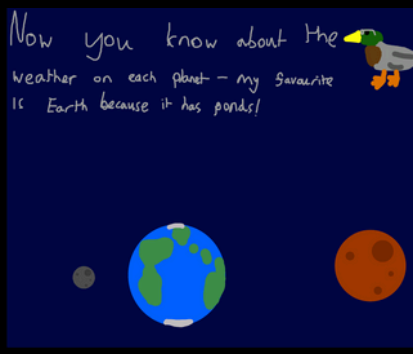
The topic of interplanetary seasons was chosen because it is a subject that both teens and adults find interesting, but often only have a rudimentary or theoretical understanding of. Students will often cover elements of the solar system during physics lessons, but these are usually taught through the lens of maths. This makes these lessons less memorable, and causes many students to disengage with the learning. A more relatable or emotive medium would leave students excited to learn, rather than putting them off of astrophysics or science as a whole.

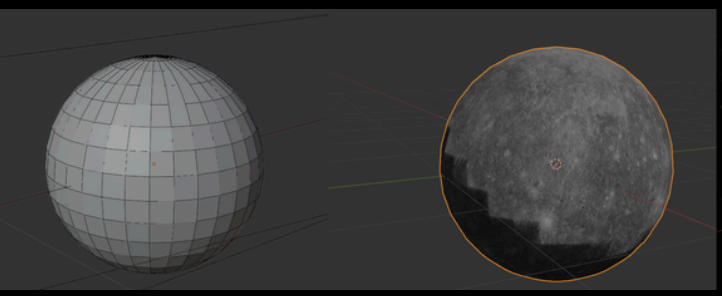


Software

The 3D modelling and animation itself was completed in Blender 4.2 and rendered with Blender’s CyclesX renderer. The main downside of this technology was the render time - rendering the 3 minutes of planet footage in the video took 32 hours. The render was denoised using OpenImageDenoise, then composited in Blender’s compositor. It was then edited using chaiNNer, a bulk image editing tool. Some scenes were interpolated using Flowframes, which generates new frames of an input video at the cost of introducing some artifacts. Audacity was used to record and denoise the voiceover, as well as integrating surround sound into the sound effects. The final video was edited together in Davinci Resolve 18 with overlay text enhanced using its Fusion suite.

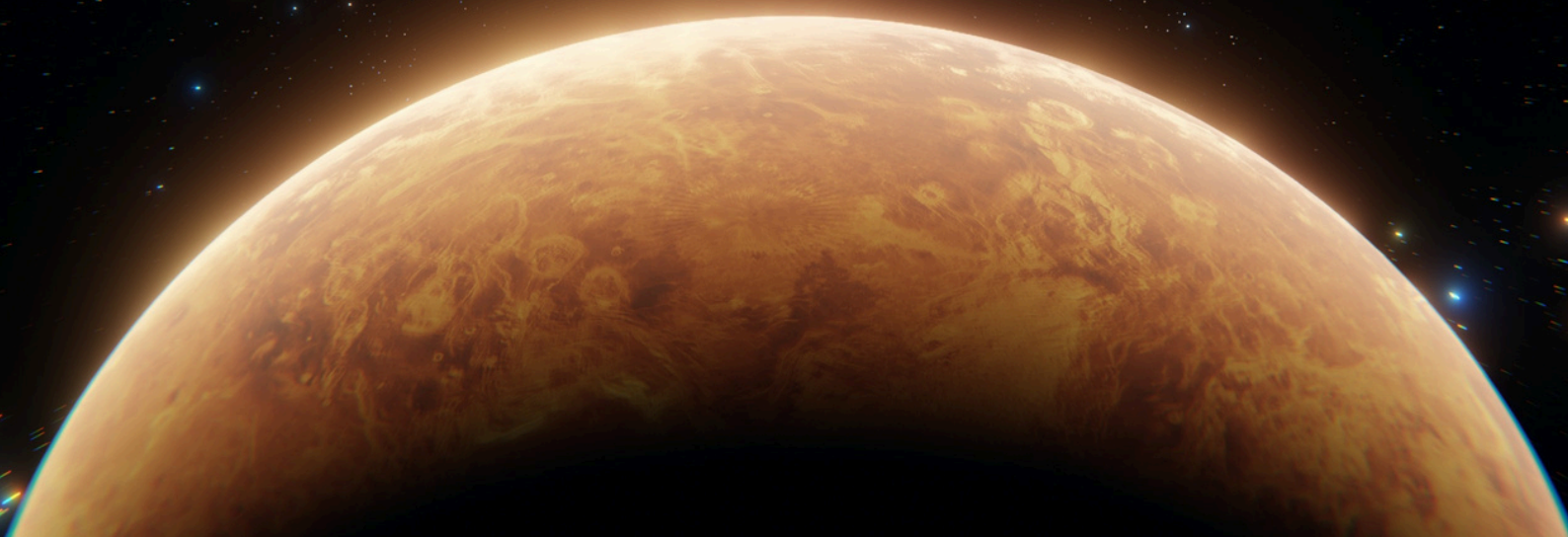
22 Secs on Per planet	What would it be like to live on each planet?	Surface Atmosphere
Explain complex idea	VR Sim Be on planet?	1 fact about each planet length of day & year





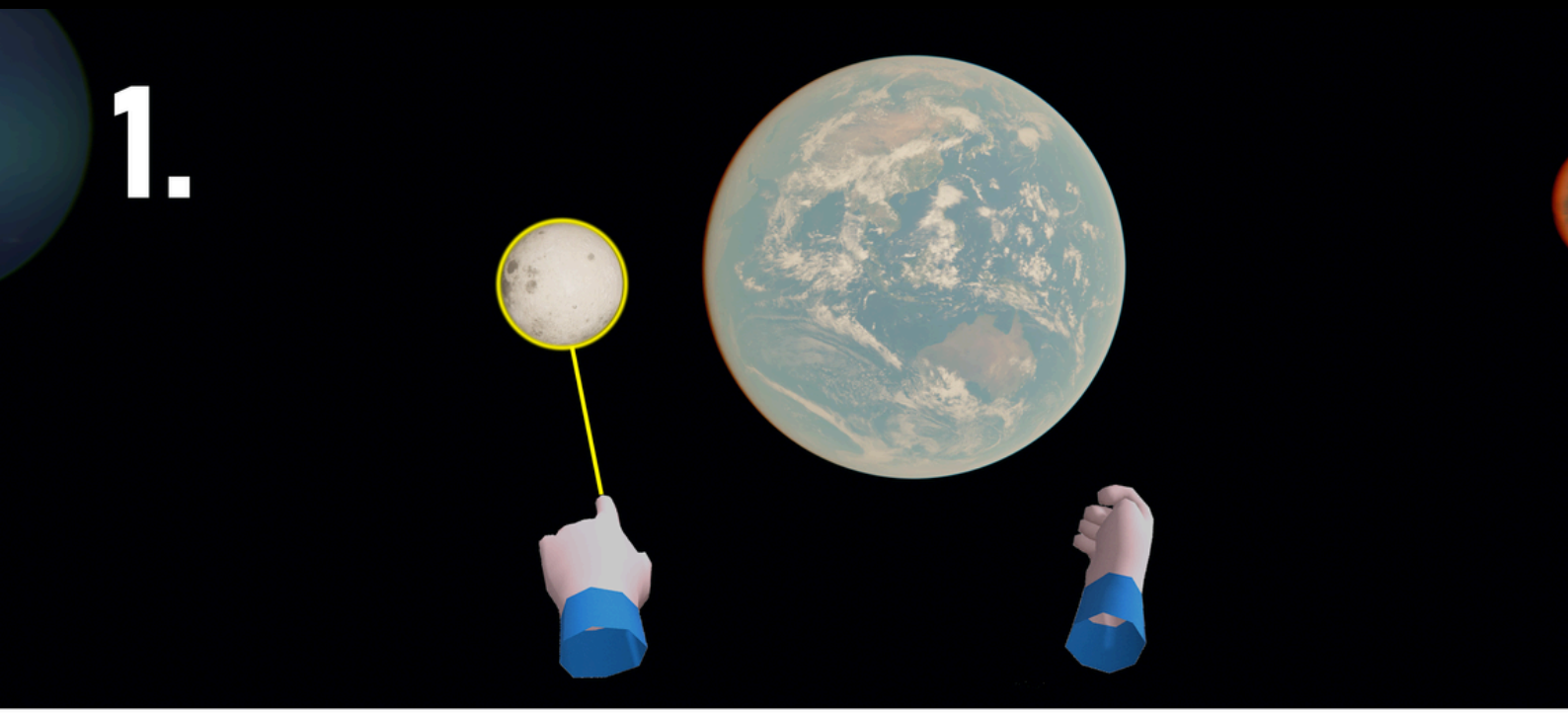
Design

Many possibilities for the method for teaching about the solar system and its seasons were considered, including AR, VR, a mobile app, an animation, and a tactile hand-controlled game. Most of these options were quickly discarded due to the relatively small scope and timescale of the project. Two storyboards were created for the initial thoughts about the project, one on the very first day, and one a few weeks in. The main improvement on this basic storyboarded premise arrived a week after it was created - the implementation of a mascot character (such as “Norman the Scholarly Duck”) who would narrate the video from his own point of view. This was inspired by a paper about the effects of mascot narrators on learning outcomes - "Live-action videos featuring mascot characters demonstrated a 23% improvement in science learning outcomes compared to traditional narration methods."(Haimbangu, M. 2023) This would also provide an opportunity for the mascot to experience the weather conditions on each planet, which while perhaps lowering the age of the target audience slightly, would make the video much more memorable.



VR Mockup

A VR version of the project was revisited further along in development, and would be a good place to start if the project were to be taken further. Players would be completely immersed and could pick and choose which order to learn in and which planets they were most interested in learning about, which offers a benefit over the medium of video. The reason VR was not considered ideal for the project initially is simply because of how few people have access to VR in their homes and daily lives. A video is much more accessible for the vast majority of people, and some of the lack of immersion can be mitigated with a high quality visual style and surround sound audio.

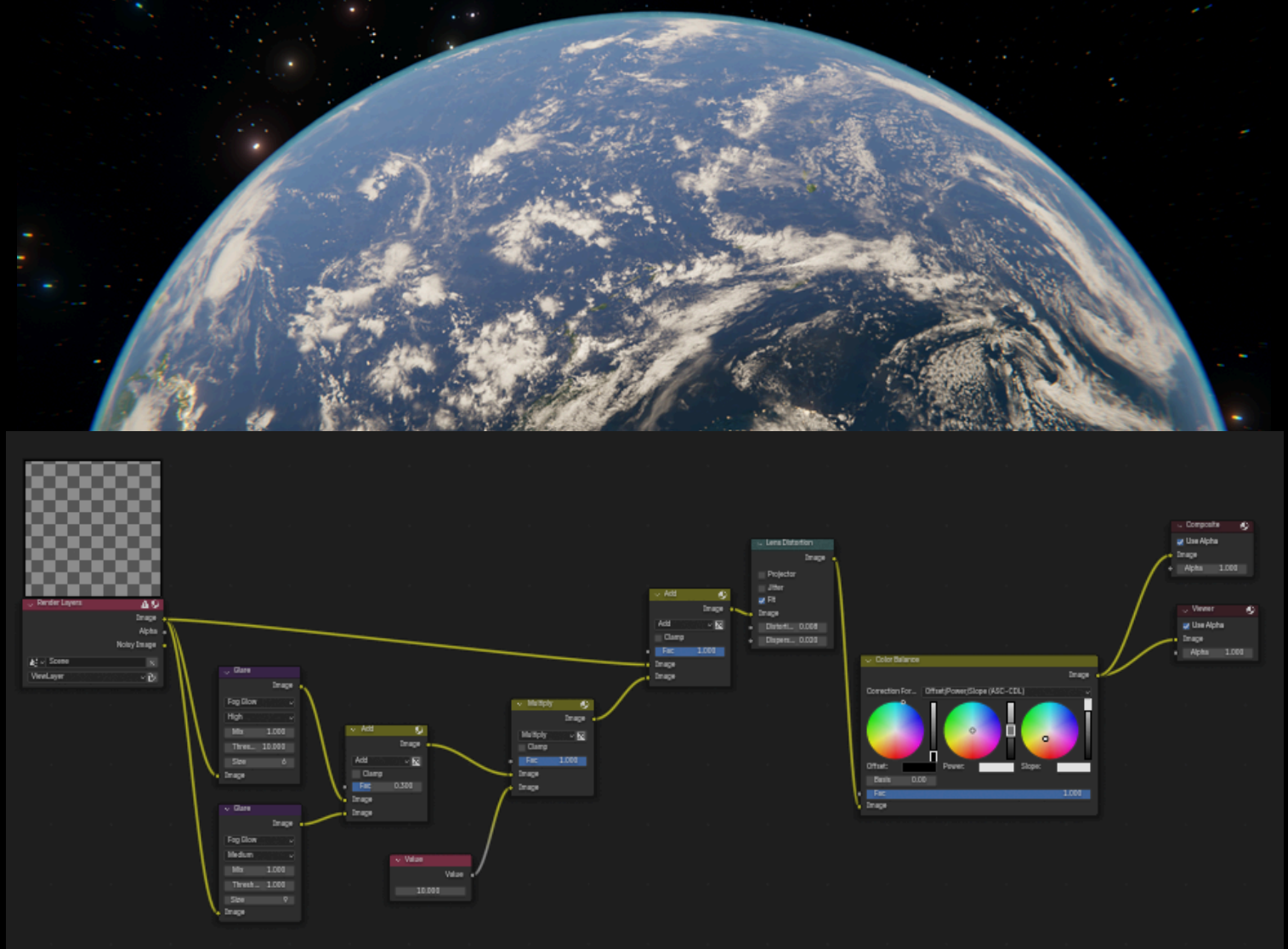


Font

The font chosen for the majority of the project was Corbel. This is because it is “designed to give an uncluttered, clean appearance on screen”(Jeremy T. 2004) while still providing a suitably sci-fi feel. Clean fonts especially help dyslexic learners - "In a study with dyslexic learners, sans-serif fonts like Arial increased reading speed by 12% and comprehension scores by 8%”. (ScienceDirect 2022) In Seasons of the Solar System, the text fades in using a RandomWrite algorithm, which appears computational in nature, giving viewers a futuristic feeling. The text also has bloom added, which aids its readability against the high contrast background, and gives the impression of being holographic, further adding to the futuristic feel.

Colour and texture

The planet textures were taken directly from photography by NASA to ensure that they were as accurate as possible. Even the Earth’s cloud textures were sourced from real satellite imagery. Because the target audience is teenagers and adults, not children, it was determined that full 3D realism would be more engaging than a more painted/cartoon style or a 2D animation. The white text and black background creates great contrast, making it readable. The stars in the background are drawn using a custom noise-based shader created in Blender, which ensures they are positioned in loose groups like real stars. The shader also colors the stars in a gradient from blue to red, which is accurate to real life, where the hottest stars are blue and cooler stars have more of a red hue.



Accuracy

Many of the design choices in the development of the project were between ease of production and accuracy to real life. In the majority of these cases, making the final video as accurate to real life was deemed most important - "By embedding real-life contexts into educational narratives, comprehension rates improved by over 30%, particularly for abstract scientific concepts."(Hinde, K. et al. 2021) For example, the rotation speeds of each planet are to scale (timed such that Earth rotates exactly 10 times over the course of the video). This is vital for getting across the vast differences in the conditions on each of these planets, as it allows viewers to visually see how much faster Jupiter spins than Earth, for example, and how that might contribute to the extreme winds that occur there. Many other aspects of the video are to scale with real life, such as the sizes of the planets and the distances between them.

Seasons of the Solar System Render

Reference Image (NASA Photo)

Audio

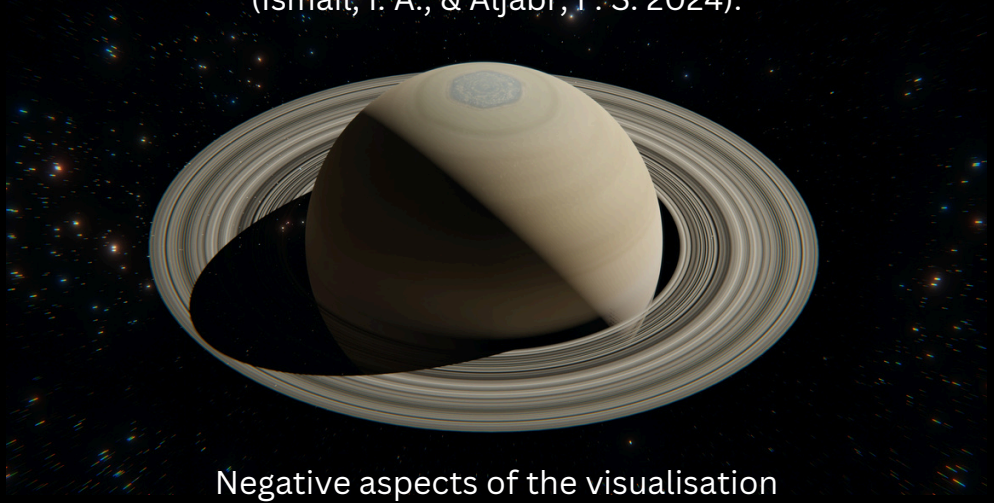
A surprisingly significant challenge was perfecting the audio for the project. A number of layers are present, namely background music, sound effects and the voiceover containing the majority of the information. The sound effects were the most challenging, as they were designed to be very natural and difficult to notice for the average viewer, while still instilling a sense of deep wonder about the cosmos. This is one area where the project departed from realism, as various air movement sound effects were added for when the camera is zooming towards or rotating around planets, while in reality there is no air in space. The video felt quite empty without these effects, even though they are not strictly possible in real life, so they were added.

Intended Delivery Methods

Due to its status as a video, the project can be distributed over any online connected device. Although initially created in a 16:9 aspect ratio, which makes it perfect for desktop viewing, the animation could be easily manipulated to fit a vertical aspect ratio, which would give it an opportunity to be spread via platforms such as TikTok, which contains a large proportion of the video's target audience. Because the content is both engaging and informative, it may do particularly well on these platforms, and because each planet gets its own 30 seconds of focus, it could be edited into 9 individual short form videos, each of which would help to advertise the others. - "Short-form videos on platforms like TikTok and YouTube Shorts generate 2.5 times more engagement compared to traditional long-form content." (ResearchGate, 2021)

Positive aspects of the visualisation

The visual fidelity achieved was much greater than expected at the beginning of the project. This is largely due to the increase in skill at using Blender and Davinci Resolve that occurred over the course of the project. The same is true of the audio, as the inclusion of large amounts of custom edited high fidelity surround sound audio was not considered at the beginning of the project. The end result feels only two minutes long because of the impactful yet concise pacing. The script for the voiceover sounds very powerful and provokes a strong image in the mind of what it would be like on the surface of each planet. This is a great effect to have, as "emotion and cognition are intertwined in adult learning, where emotionally engaging material enhances memory retention and critical thinking." (Ismail, I. A., & Aljabr, F. S. 2024).

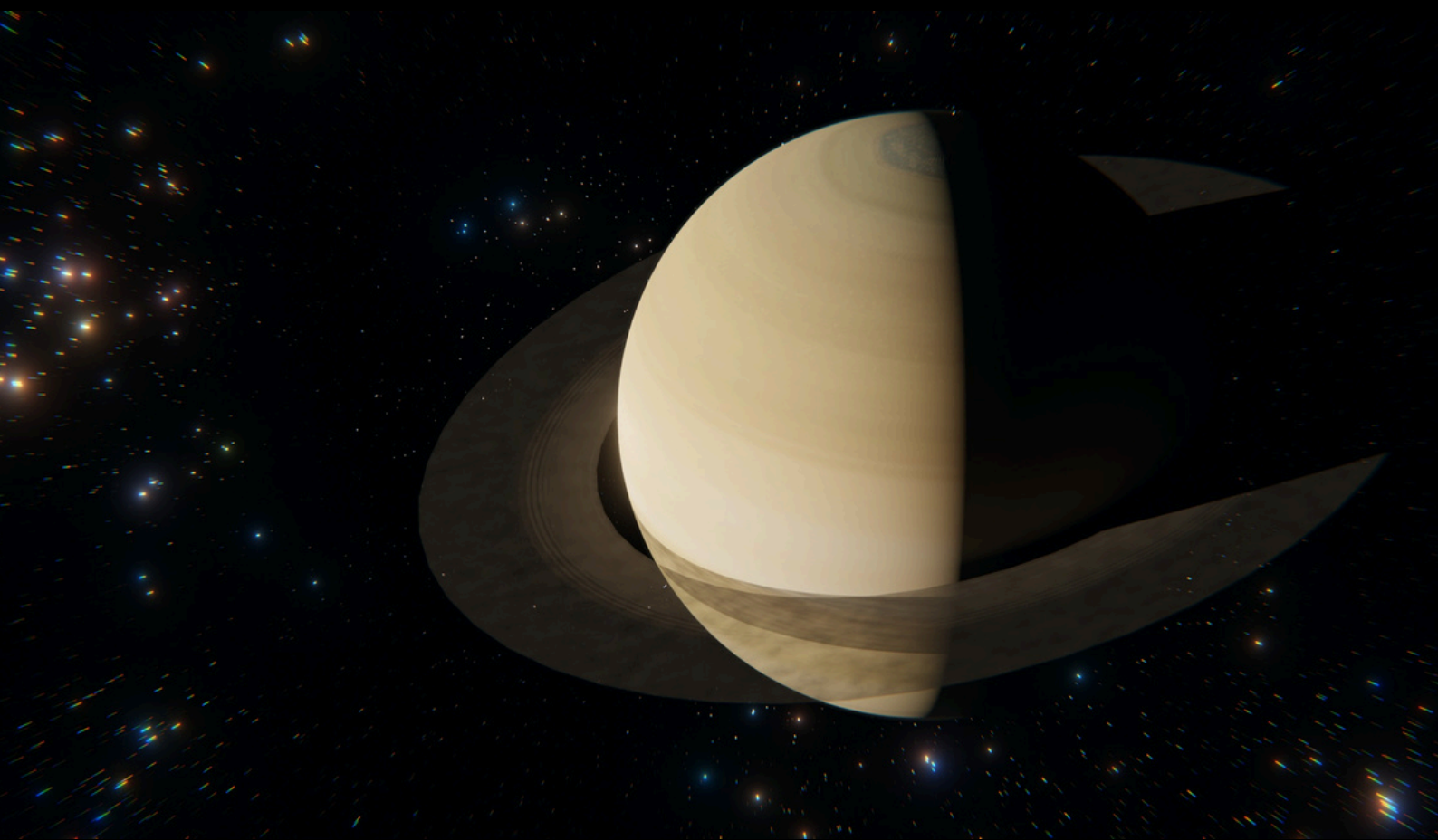


Negative aspects of the visualisation

Some minor rendering issues remained, which if noticed somewhat ruin the illusion of the rest of the animation. These could not be fixed within the scope of the project, as several of them would have required the re-rendering of large parts of the animation. If these issues were noticed earlier in development, they could have been recreated without hindering the video editing and audio stages of the project. One of these issues was strange lines that get drawn vertically over Pluto. These are most likely due to floating point imprecision, as Pluto is so far away from the sun in real life that even with the distances divided by 10, it is still far enough away from the origin in Blender to cause visual distress to the vertices. Another issue is Saturn's rings not being drawn until the camera gets quite close. This can be quite jarring if a viewer happens to be looking at the upcoming planet, but was necessary to make the angle of Saturn's rings more physically accurate. It was very challenging throughout the project to keep the script and voiceover length down while still communicating as much information as possible. Due to the timespan of the project being relatively short, there was little scope to add the mascot character idea that was initially planned - this was mostly due to a lack of animation/rigging knowledge, and learning these skills which are, in industry, entire jobs by themselves, was not within the scope of the project.

Future Developments

The animation could be adapted into a VR experience to increase immersion even further, albeit for the small percentage of target audience members who have access to VR gear. It would be a natural progression to do a second version of the video that focuses on aspects other than the seasons and weather conditions on each planet, for example one with an emphasis on the lengths of years and days. The main development that could be made would be to include the mascot narrator proposed near the beginning of development, as had the scope allowed for it, a mascot could have been a great lens through which to justify many different skews of voiceover, for example a comedy one which could appeal to adults, or a more friendly one to appeal to younger children.



References:

Research materials:

Ismail, I. A., & Aljabr, F. S. (2025). The Interplay of Emotion and Cognition in Adult Learning - https://www.igi-global.com/chapter/the-interplay-of-emotion-and-cognition-in-adult-learning/360035

Design Principles for Inclusive Education, ScienceDirect (2022). https://www.sciencedirect.com/topics/social-sciences/inclusive-education

Hinde, K. et al. [2021]. March Mammal Madness and the power of narrative in science outreach. https://elifesciences.org/articles/65066

Real-Time Intermediate Flow Estimation for Video Frame Interpolation, 2021. https://arxiv.org/pdf/2011.06294

The Role of Short-Form Content in Modern Education, ResearchGate, 2021. https://www.researchgate.net/pdf/2021.0705

Planet information from NASA and JPL https://www.nasa.gov/

Assets:

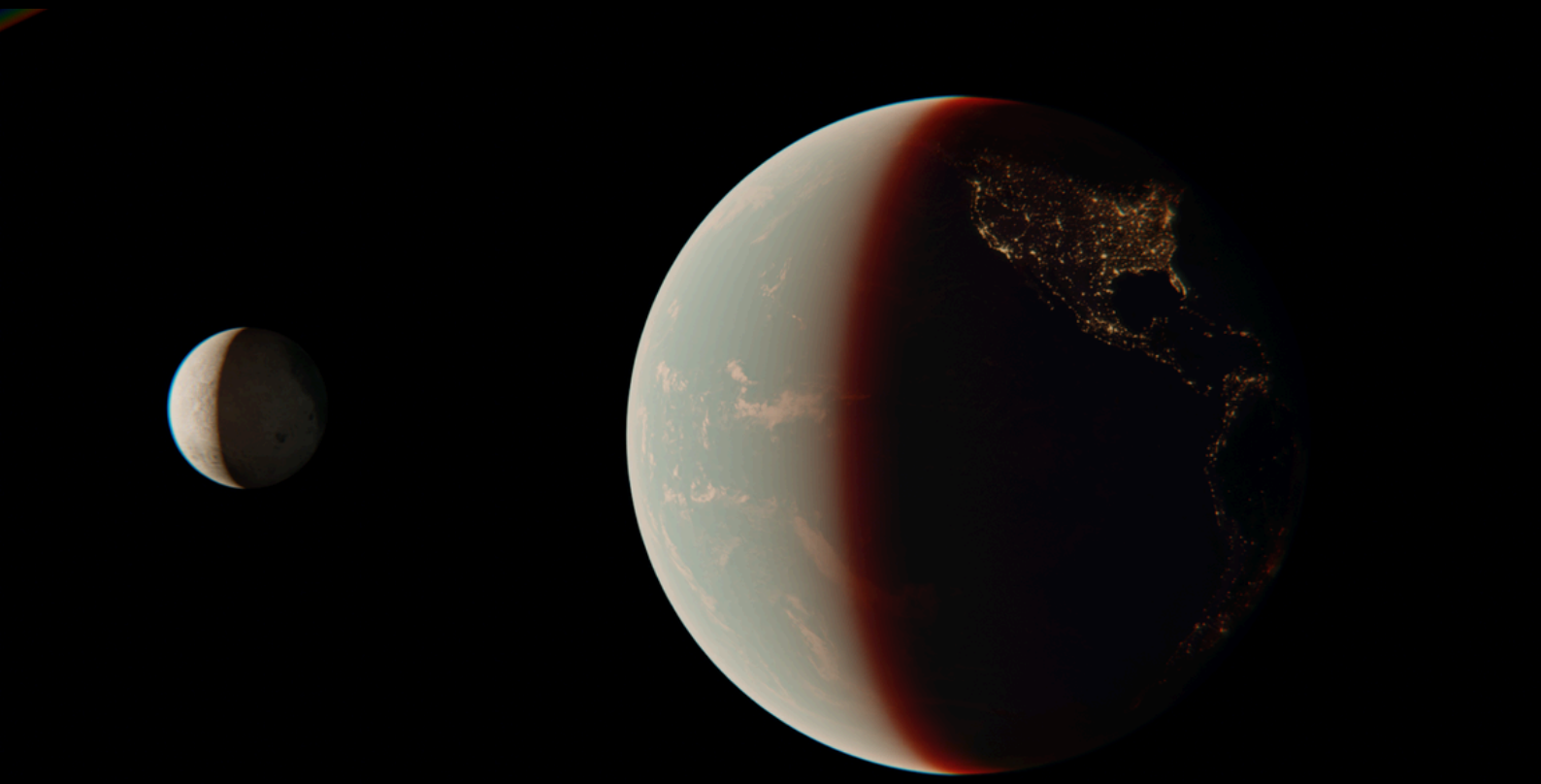
Saturn photo from NASA/JPL: https://www.nasa.gov/image-galleries/
Planet Textures from NASA https://nasa3d.arc.nasa.gov/images
Corbel font by Jeremy Tankard - https://typographica.org/on-typography/microsofts-cleartype-font-collection-a-fair-and-balanced-review/

Learning materials:

Planet tutorial from THEO https://youtu.be/3qJZGGHc3lg
Planet tutorial from CG Geek https://youtu.be/V4HNIbDn4K4
Moon tutorial from BlenderVitals https://youtu.be/6G2Rk9eB4uU

Audio:

Music from Alexander Nakarada https://youtu.be/LG9sRa9KdoA
Music from Yan https://youtu.be/ofRrywx4v08
SFX from Lukas Eriksen https://youtu.be/iPToKmyZi74



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