VCU College of Engineering

Project CS-25-321 Virtual Reality Space Game

Project Proposal

Prepared for

NASA/ASU

By

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Under the supervision of

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Executive Summary

The NASA Psyche mission is designed to explore a metal-rich asteroid, believed to be the exposed nickel-iron core of an early planet. This asteroid presents a unique opportunity for scientists to study the foundational elements of terrestrial planets like Earth. Psyche's composition could provide valuable insights into the processes that shaped planets through violent collisions and accretion during the early formation of the solar system.

As part of our capstone project, a virtual reality (VR) game is being developed to raise public awareness about the NASA Psyche mission. The game is designed for students from elementary to high school and will be showcased at promotional events to engage a general audience.

The primary goal of the project is to create an immersive VR experience that offers users an engaging and realistic space environment. The game will feature simple and intuitive controls to ensure ease of interaction while allowing users to interact with specific objects within the environment. The design will provide multiple modes of interaction, enabling flexibility and enhancing the user experience.

The game will feature a navigable map with five interactable rooms, designed to function like an escape room with puzzles and clues for users to solve. We will rigorously test the design to ensure it meets expectations and is fully playable. The design will follow established guidelines, including prototypes and adherence to time constraints to ensure project completion within 3-4 months. The game will be developed using Unity to ensure compatibility with all major VR headsets, such as Meta Quest 2 & 3 and Apple Vision Pro. The game will offer two modes: a 30-60 minute main storyline and a shorter event mode with a playtime of 2-3 minutes.

Prototypes, project outlines, and other updates will be regularly delivered to both the project sponsor and the advisor, with deliverable dates aligned to sponsor meetings for effective communication. Additionally, academic deliverables will be submitted throughout the project timeline and evaluated by our CMSC451 professor as part of the course requirements. Our deliverables section provides more specific information and dates.

Key accomplishments include the completion of the project proposal, team contracts, initial communication with sponsors, and the development of the game’s overall storyline. A project timeline has also been established, which is detailed in Appendix 1.

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Section A. Problem Statement

The Psyche mission aims to explore a unique, metal-rich asteroid, believed to be the exposed nickel-iron core of an early planet, located between Mars and Jupiter. This asteroid offers a rare opportunity to study the building blocks of terrestrial planets like Earth, as metallic cores are typically hidden beneath rocky mantles. Scientists speculate that Psyche's composition could help reveal the processes that shaped planets through violent collisions and accretion during the solar system's early formation (Psyche). Arizona State University leads the mission, with NASA's Jet Propulsion Laboratory managing operations, while spacecraft development is led by Maxar Technologies. The mission's scientific objectives include determining Psyche's structure, topography, and elemental composition using advanced instruments such as a multispectral imager, magnetometer, and gamma-ray spectrometer (Psyche).

Asteroid Psyche's mass, approximately 220 billion billion kilograms, is composed of up to 95% nickel and iron, making it an important subject for planetary science (Mann). It is hypothesized that Psyche could be the remnant of a protoplanet whose outer layers were stripped away through collisions billions of years ago. This asteroid, which is significantly smaller than Earth's moon, is considered an ideal candidate for studying planetary cores, which are otherwise inaccessible beneath a planet's surface (Mann). Scientists will analyze Psyche's magnetic and gravity fields to test theories about its formation and structure (NASA's Psyche Mission..).

Once the spacecraft reaches the asteroid in 2029, it will spend approximately two years mapping its surface and analyzing its composition (Mission). The spacecraft's state-of-the-art payload will include instruments to investigate Psyche's internal structure, magnetic fields, and elemental makeup, providing unprecedented insights into the asteroid's origins (Psyche Spacecraft). Additionally, the mission will test new laser communication technology that could revolutionize data transmission from deep space (Psyche Spacecraft). This groundbreaking exploration of Psyche is expected to enhance our understanding of planetary formation and the violent processes that shape celestial bodies (NASA's Psyche Mission).

NASA's Psyche mission presents an opportunity to educate and inspire public interest in space exploration. Virtual reality (VR) is increasingly popular among children, making it a good choice for promoting the Psyche mission at public events and demos. There is an unmet need for a VR experience that can introduce children and the general public to space science and exploration in an engaging, immersive way. There needs to be a continued interest in the mission over five years, requiring an engaging way for people to learn about the mission.

Our capstone project aims to develop a VR game to raise awareness about NASA's Psyche mission. The game is targeted at students from elementary to high school and will be played at promotional events for the general public. The game is designed as an escape room on board a futuristic craft going to Pysche after a successful first mission. The overall storyline follows the craft having a breakdown and the user navigating through the spacecraft to find the "code" that will fix the issue. Although not directly connected to the Psyche mission, it draws inspiration from space exploration environments.

The project is a collaboration between NASA Psyche Mission, Virginia Commonwealth University (VCU), and Arizona State University (ASU). Primary stakeholders include NASA, educational institutions, students, and the general public.

The game must provide an immersive experience, featuring realistic environments with dynamic and interactive objects. We face challenges as we are new to VR game development, and need to learn VR design and 3D environment creation. We also need to model the game to be accessible for people who are not used to VR technology, such as children or older interested parties.

While existing educational games on space exploration are available, most are in traditional 2D formats. The project aims to elevate existing educational games by transitioning them to VR, providing a more interactive and immersive experience. This project advances current technology in educational games by offering a VR escape room experience, allowing players to engage with space environments in a more meaningful way.

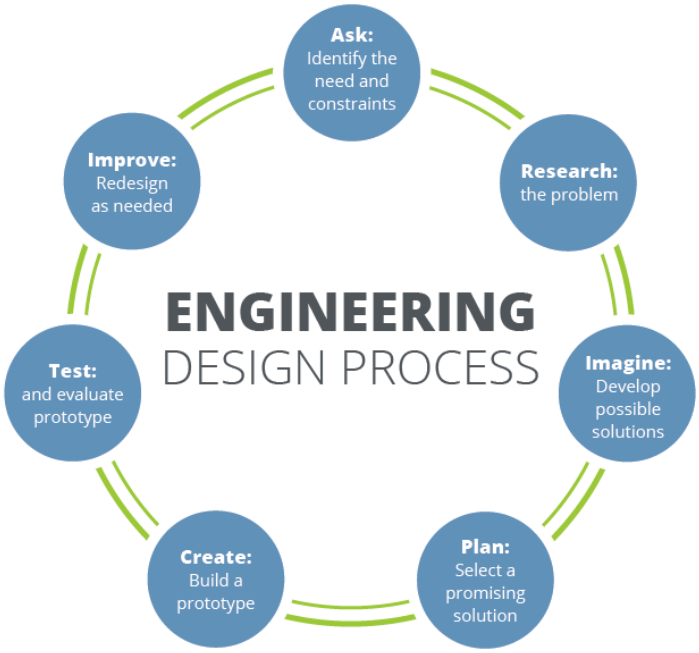


Figure 1. The iterative nature of the engineering design process [2].

Section B. Engineering Design Requirements

Our main goal for this project is to create a VR space game that will be engaging and interactive to the user. Upon our design, there will be certain constraints to consider with precise implementation and requirements. We want to mirror the famous game, escape room into VR to give the user a real-life experience when playing the game. Our requirements will mainly consist of a VR headset and unity for the creation of the game. Furthermore, we will also use assets when needed based on certain developmental parts when designing. Rigorous testing will be applied to ensure that the game works safely and correctly to provide a realistic environment to the user. Considering all of our research and ideas, our expected goal to complete this project will be approximately 3-4 months. The time constraint could be problematic; however, considering the main goal, we will do our best to provide the game with full functionality.

B.1 Project Goals (i.e. Client Needs)

Our overall goal is to produce a game in VR that gives the users a cool experience. While we have numerous ideas and directions to take, we must make sure that the event mode that we implement will have a max duration of 2 minutes; however, our story mode will have a duration of 30 minutes to an hour long. Below are goals to keep in mind when delivering our game to the client:

- To provide a realistic space environment allowing users to experience an engaging setting.
- To design user-friendly controls making interaction easy and simple.
- To implement basic interactions with specific objects in the environment.
- To provide multiple modes of interaction to give the user flexibility.

B.2 Design Objectives

Our design process will provide multiple aspects in regard to the creation of the game. Below will describe the main points that the design will do:

- The design will implement a navigable map with five interactable rooms mirroring the functionality of an escape room containing puzzles and clues for the user to explore through VR.
- The design will be tested rigorously by developers and other users to ensure that our design is the outcome we expect with playable functionality.
- The design will follow our guidelines including prototypes and time constraints to complete the project.
- The design will use Unity to provide the game in VR for the user to experience with a decent frame rate playable for around 2 minutes.
- The design will be completed within a period in 3-4 months.
- The design will feature a main storyline with a playtime of 30 minutes to an hour and an event mode with a playtime of 2-3 minutes.
- The design will be playable on all major VR headsets (Meta Quest 2&3, Apple Vision Pro).

B.3 Design Specifications and Constraints

Functional Constraints

Gameplay Flow:

- Requirement: Players must progress by sequentially unlocking rooms via puzzles or minigames.
- Specification: Puzzles in each room must be designed to allow completion within 5 to 10 minutes to ensure a smooth gameplay experience and keep the pacing engaging.
- Objective: Keep player engagement high and ensure logical progression.

Environmental and Physics Constraints:

- Requirement: All movement mechanics must feel realistic given the game's space setting.
- Specification: Movement physics should be adjusted for low-gravity environments, simulating asteroid surface interactions.
- Objective: Provide a realistic, immersive experience while navigating or interacting with the Psyche environment.

Cost Constraints

Development Budget:

- Requirement: Development costs should remain within the allocated $1000 budget.
- Specification: Costs for assets and Unity integrations must not exceed 200 of the budget, leaving room for unexpected expenses.
- Objective: Ensure the project stays financially feasible while delivering high-quality gameplay.

Asset Use:

- Requirement: Leverage readily available Unity assets or free 3D models.
- Specification: At least 70% of game assets (models, textures) should be sourced from existing resources or Unity’s asset store.
- Objective: Keep asset acquisition cost-effective without sacrificing visual quality.

Hardware Constraints

Platform Compatibility:

- Requirement: The game must run smoothly on most compatible devices.
- Specification: Target a minimum of 30 FPS on a system with Intel Core i5, 8GB RAM, NVIDIA GTX 1050 or equivalent.
- Objective: Ensure accessibility for a broad player base, especially those with standard hardware.

Power and Data Constraints (VR and High Fidelity Sections):

- Requirement: Minimize power consumption in VR portions and drone navigation segments.
- Objective: Ensure a smooth experience without overloading VR-capable hardware or causing performance drops.

Maintainability Constraints
Code Modularity:

- Requirement: Each game feature (e.g., puzzles, physics) must be implemented as separate, modular scripts.
- Specification: Ensure by separating functionalities into distinct scripts, making future updates or adjustments simpler.
- Objective: Allow easier maintenance and expandability for future content or features.

Error Logging:

- Requirement: Identify and log bugs or performance issues.
- Specification: Implement Unity's logging system to monitor for critical errors in each game phase.
- Objective: Enhance reliability and track performance issues for timely troubleshooting.

Usability Constraints
Player Control and Navigation:

- Requirement: Controls must be intuitive, especially for complex VR navigation.
- Specification: Implement a tutorial sequence within the first 3-5 minutes of gameplay covering essential movement and interactions.
- Objective: Ensure new players quickly learn controls to avoid frustration and improve retention.

Accessibility Options:

- Requirement: Make the game accessible to players with visual and auditory needs.
- Specification: Provide text-based options and subtitles for all dialogue.
- Objective: Broaden accessibility to improve inclusivity and usability.

Schedule Constraints
Development Timeline

- Requirement: The game must be completed within a 6-5-month timeline.
- Specification: Aim for two major milestones—a playable demo within 6 months and the final version by month 8. Implement bi-weekly sprints to ensure steady progress.
- Objective: Stay on schedule, maintain team motivation, and deliver a polished product within the budget and timeline.

Aesthetic Constraints
Futuristic and Psyche Mission-Themed Aesthetic:

- Requirement: The design must evoke a realistic sci-fi atmosphere aligned with the Psyche mission's objectives.
- Specification: Each room's design must include at least 3 unique mission-relevant elements (e.g., Psyche maps, mineral samples) to reinforce the theme.
- Objective: Increase immersion through consistent visual theming that aligns with the mission narrative.

B.4 Codes and Standards

Standards

NASA Style Guide and Image Policies:

- Standard: Follow NASA's guidelines on image usage, terminology, and branding to ensure an authentic experience.
- Relevance: Maintain consistency with NASA's public image and adhere to their graphic standards, particularly for visuals and any representation of the Psyche mission.

ISO 9241 Ergonomics of Human-System Interaction:

- Standard: This standard includes principles for usability and human-computer interaction, particularly around ease of use and accessibility.
- Relevance: Ensures that game controls, interfaces, and interactions meet ergonomic principles, which is essential for VR and interactive systems.

IEEE 29148-2018 Requirements Engineering Standard:

- Standard: Defines practices for developing and managing requirements, ensuring all functional and non-functional needs are documented and traceable.
- Relevance: Helps document game requirements thoroughly, ensuring all features, constraints, and objectives align with player expectations and are traceable throughout development.

ASTM F3059-14 Standard Guide for Characterization and Performance of Gaming Systems:

- Standard: Establishes guidelines for testing and evaluating the performance of gaming systems, particularly for frame rate, latency, and interaction response.
- Relevance: Provides benchmarks for testing performance in Unity and VR environments to ensure smooth and responsive gameplay for users.

W3C Web Content Accessibility Guidelines (WCAG) 2.1:

- Standard: Offers guidance on making digital content accessible to people with disabilities, including those with visual or auditory impairments.
- Relevance: Ensures that in-game text, AI dialogue, and color-coded puzzles are accessible, expanding inclusivity for players with disabilities.

Codes

NASA Section 508 (Rehabilitation Act) Accessibility Requirements:

- Code: Mandates that all federal digital content and interfaces are accessible to people with disabilities.
- Relevance: Ensures that the game meets accessibility standards similar to those required by federal entities, enhancing usability for all players.

Children's Online Privacy Protection Act (COPPA):

- Code: Requires that online games do not collect personal data from users under 13 without consent and restricts in-game communication to prevent data sharing.
- Relevance: If the game is accessible to children, this code ensures no personal information is collected, and in-game communication remains private.

NASA Psyche Brand Guidelines:

- Code: Provides guidelines on branding, logo usage, and content standards related to NASA's Psyche mission.
- Relevance: Ensures that the game remains true to NASA's branding requirements, particularly for visuals and references to Psyche mission-related content.

Occupational Safety and Health Administration (OSHA) VR Safety Requirements:

- Code: Although primarily for real-world applications, OSHA has guidelines on VR development to prevent user discomfort or harm.
- Relevance: Ensures VR minigames adhere to safety standards, such as minimizing motion sickness risks and maintaining comfort for prolonged use.

Section C. Scope of Work

C.1 Deliverables

During this project, many prototypes and planning/outline deliverables will be delivered to the project sponsor and advisor to follow along with progress. The deliverable dates will generally line up with sponsor meeting dates for optimal communication among all parties. This list will also include academic deliverables that have been assigned throughout the school year and will be graded by the CMSC451 professor and labeled as academic milestones. Below are the project deliverables listed in order, from the first semester of Senior Project Design to the second semester of Senior Design II and the end of the project and the final project submission:

First semester:

- **General idea outline:** Completed before sponsor meeting to propose project idea. Gives a general outline of the game, a visual reference, and an idea of how the story will progress.
  September 30th

- **Project Proposal** (academic):
  October 11th

- **Detailed plan of event room:** description and written plans for event room
  October 23rd

- **Fall Design Poster (academic)**
  November 15th

- **Blockout of event room:** Unity block out of the first event room, featuring a usable character and the general shape of the room
  November 18th

- **First prototype (event room):** prototype of the event room featuring wall designs, a story, and a few interactable objects, mostly to practice working together and test what features work, make sense, are too easy/hard, etc.
  December 2nd

- **Preliminary Design Report (academic)**
  December 9th

Second Semester:

- **Test report of first prototype**: after testing the first prototype on people we know with various levels of VR and game knowledge, we'll report what we learned about the player experience and what changes we can make for the future. The report will feature sections: User feedback (overall experience, likes, dislikes, rated difficulty and points of struggle,

and suggestions), and Developer Report (what we need to change, how we'll use their feedback, and what we overall learned from having the game played)
January 17th

- **Storyline and plan of the full game**: A detailed storyline for the main game, including storyboards, scene layouts, description of main puzzles to be made, and split of work between teammates.
  January 31st

- **Full Game Prototype:** A playable prototype of the full game room with at least 50% of implemented functionality.
  February 24th

- **Full Game prototype 2:** Second prototype of full game with testing and implementation of more elements, about 75%
  March 17th

- **Full Game Final:** Full game with all playable functionality, completed a few weeks before the EXPO to allow for testing and tweaking, as well as a small time cushion in case anything runs long and to prepare our EXPO presentation
  April 7th

- **Final Design Report (academic)**
  Unknown

- **Capstone EXPO Poster and Presentation (academic)**
  Unknown

Our project requires all developers to learn a new software and programming language, along with creating a highly creative storyline and game elements that may evolve. As a result, we anticipate a learning curve, which introduces potential risks to the project's completion and delivery. There may be additional risks associated with the completion and delivery of the project in relation to access to physical resources and accessing the source code simultaneously for the project (which cannot safely be done on Unity and Github). Below we explain these risks and our plan to mitigate complications.

- **Virtual Reality headset access for developing and testing:** There is a Virtual Reality lab at VCU with many headsets to test on, and we will make a schedule of team and individual usage with our advisor when we begin development of the prototype. If this poses too much difficulty we may purchase our own headset to be stored safely and passed between group members on a schedule. Buying one of the more popular and cheap headsets (such as the Meta Quest) is in our project budget and would make sure publicly available headsets are tested on and usable.

- **Unity and Github scene conflicts:** Unity scenes can only be worked one by one person at a time or the work will overlap and cause conflicts. Because of this, we will be sectioning off the work into main rooms and also have thorough communication between ourselves about who is working at what time. This way, work is mostly separated but also heavily communicated when it overlaps thus mitigating overlap issues.

- **Asset creation**: None of the team members have knowledge of asset creation or 3D modeling, so this is a setback in addition to a lack of knowledge of Unity. Because of this, we will be using a simple and less realistic art style, as well as purchasing many of our assets from the Unity Asset Store. If necessary, one of our developers can learn basic 3D modeling (likely Blender) for specific assets.

C.2 Milestones

Milestones are major project phases or tasks that need to be completed in order to ensure the project deliverables. Most major deliverables from above have at least one milestone that we should be working towards to aid us in learning Unity, and keeping us on track so that we get everything done in an efficient manner.

- **Personal Unity environment practice:** block out of personal Unity environments to practice using Unity and learn the software
  October 2nd

- **Unity Github Repository setup:** connect the event room repository and set all file systems for all team members to access and edit
  November 11th

- **Create a test report form** for users to fill out during each prototype test
  January 15th

- **Full Game rooms Blockout:** Blockout of the main game based on storyline and puzzle report, to aid in our prototype development.
  February 24th

- **Full Game Prototype 2 testing report:** Report of testing the full game prototype on others (people we know, members of the project team not associated with the development of the game).
  March 3rd

The project approach will be a mixture of waterfall and agile development. Our program is split into 2 major sections; the first semester of Senior Design and the second semester. The first semester is focused on this report, planning, and designing. The second semester will be focused on building and finalizing our final product. This setup follows a more sequential waterfall-like approach, but we will also be utilizing some agile methodologies in the following ways:

- **Deliverables for each major element of the project are no more than 4 weeks apart**, with milestones for each longer stretch in the middle. This gives us something similar to 2-week sprints where we will be making major progress and then assessing the work and our project direction.
- **We will start by working on the event room**, which is a smaller version of the full game to get a handle on controls and our workflow. Then there will be *3 major iterations* of the full game, ending a few weeks early to allow for finalization. This allows the team to brainstorm new ideas as we're creating and developing and always be thinking about creating the best experience possible.
- **Weekly meetings and frequent communication as needed.** The group meets for 30 minutes to an hour every week to talk about major deliverables coming up, our progress, and work on assignments together.
- **Testing feedback loops**. After every prototype, we will be testing the product on others and having them fill out a testing survey, then making our report of what we will do with this feedback and implementing it into the next iteration.

C.3 Resources

Resources needed for this project are mostly free software online and thus can be learned and used without any purchasing or complicated acquisition. We will be using version control software to save, document, and collaborate on our code, in addition to many types of software for game development and modeling. Key resources include:

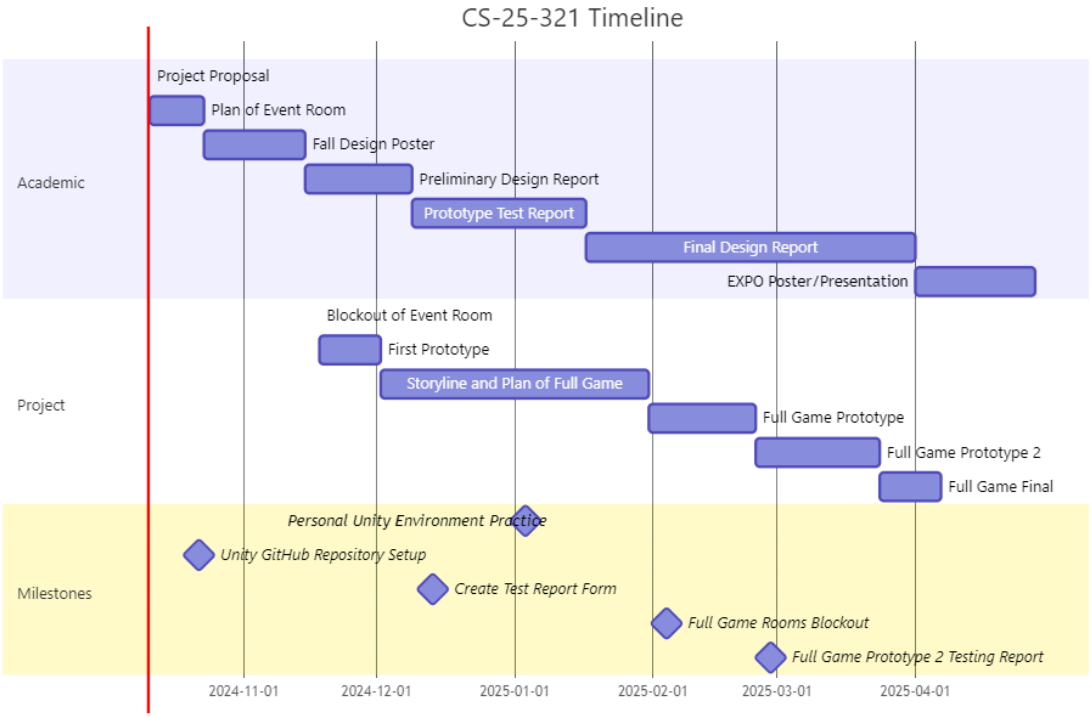
Hardware:

- Multiple VR Headsets: We will need access to multiple different types of VR headsets to develop and test our game on, especially the Meta Quest 3. We can access these headsets and controllers from VCU's VR lab, and if necessary can use our budget to purchase one.
- High-performance computers: computers or laptops capable of handling VR development and rendering. These are either already owned or can be used at VCU's computer lab facilities.

Software:

- Unity: This will be our primary game engine. It is free to use and has many assets in its store, making it a crucial resource for new developers. We will also be making use of the Unity asset store. Unity has a wide variety of free and paid assets including models, textures, and sound effects that we will purchase and use to make our game more realistic and immersive.
- 3D Modeling Software: Depending on our workflow, we may be making our assets for this project. If so, we will use Blender to create 3D assets.
- Version Control:
    - Git and Github: Necessary for collaborating, tracking changes made and by who, and managing the development process effectively. We may be making use of GitLFS (Large File System) to store and work with large files while developing.

Appendix 1: Project Timeline



Appendix 2: Team Contract (i.e. Team Organization)

Step 1: Get to Know One Another. Gather Basic Information.

Task: This initial time together is important to form a strong team dynamic and get to know each other more as people outside of class time. Consider ways to develop positive working relationships with others, while remaining open and personal. Learn each other's strengths and discuss good/bad team experiences. This is also a good opportunity to start better understanding each other's communication and working styles.

Team Member Name	***Strengths each member brings to the group***	***Other Info***	***Contact Info***
Akshara Rajesh	Communication, fast learner, and team worker	I enjoy spending time outside, watching TV, and reading new books. I have experience in Java, Python, C++, and SQL.	rajesha3@vcu.edu 703-338-4755
Ava Shilling	Problem-solving, good communication, on time	I like playing games and VR and I chose this project because it sounds very interesting and lines up to my interest. Worked with Java and C, Git and Github.	Shillingar@vcu.edu 540-255-6609
Quinton Jones	Ambitious, leadership qualities, perseverance	I like watching TV shows and anime, I love sports, and I enjoy playing video games, and bowling. Experienced with Java, Python, and SQL with a little experience with front-end development using React.	jonesql@vcu.edu 804-221-2401
Peter Nguyen	Hard worker, determined	I like games, fishing, and cooking. I have experience in Java, C++, python,	nguyenph11@vcu.edu 904-972-4126

Other Stakeholders	***Notes***	***Contact Info***
Rodrigo Spinola - faculty advisor	*Professor at VCU - available to talk/meet Mondays-Wednesday-Friday in the morning*	*spinolaro@vcu.edu*

Cassie Bowman - Sponsor	Associate Research Professor School of Earth and Space Exploration Arizona State University Co-Investigator, NASA Psyche Mission	*cbowman5@asu.edu*

Step 2: Team Culture. Clarify the Group's Purpose and Culture Goals.

Task: Discuss how each team member wants to be treated to encourage them to make valuable contributions to the group and how they would like to feel recognized for their efforts. Discuss how the team will foster an environment where each team member feels they are accountable for their actions and the way they contribute to the project. These are your Culture Goals (left column). How do the students demonstrate these cultural goals? These are your Actions (middle column). Finally, how do students deviate from the team's cultural goals? What are ways that other team members can notice when that culture goal is no longer being honored in team dynamics? These are your Warning Signs (right column).

Resources: More information and an example of Team Culture can be found on the Biodesign Student Guide "Intentional Teamwork" page (webpage | PDF)

Culture Goals	***Actions***	***Warning Signs***
Finishing goals on time	- Set up deadlines in a shared calendar - Send a reminder through Discord the day before the due date	- Student misses deadlines consistently - Student misses deadlines afterward – the issue is brought up with the faculty advisor
Informing the group of any delays in completing assignments	- Stay up to date with each other's project responsibilities - Set reasonable deadlines and communicate when an extension is needed	- Student shows up for weekly meeting with no considerable work done - Student consistently does not finish work or communicate – the issue is brought up with the faculty advisor
Keep an organized schedule and workflow.	- Set schedules and dates through Google Calendar - Allocated work/ document of everyone's roles	- Student is disorganized, not fulfilling the correct role - Student is disorganized and does not perform assigned work - the issue is brought up with the faculty advisor

Step 3: Time Commitments, Meeting Structure, and Communication

Task: Discuss the anticipated time commitments for the group project. Consider the following questions (don't answer these questions in the box below):

- What are reasonable time commitments for everyone to invest in this project?
- What other activities and commitments do group members have in their lives?
- How will we communicate with each other?
- When will we meet as a team? Where will we meet? How Often?
- Who will run the meetings? Will there be an assigned team leader or scribe? Does that position rotate or will the same person take on that role for the duration of the project?

Required: How often you will meet with your faculty advisor, where you will meet, and how the meetings will be conducted. Who arranges these meetings?
See examples below.

Meeting Participants	***Frequency Dates and Times / Locations***	***Meeting Goals Responsible Party***
Students Only	*Every Thursday at 5:15 pm*	*Update group on day-to-day challenges and accomplishments*
Students Only	*If needed, meet on discord*	*Update team on unexpected challenges/ revisions*
Students + Faculty advisor + Project sponsor	*Every other Monday (mostly) at 5:30 pm*	*Update faculty advisor and talk to sponsor about current work and expectations*
Students + Faculty advisor	*Every Wednesday at 10 am in his office*	*Update the faculty advisor and get answers to our questions*

Step 4: Determine Individual Roles and Responsibilities

Task: As part of the Capstone Team experience, each member will take on a leadership role ***and*** contribute to the overall weekly action items for the project. Some common leadership roles for Capstone projects are listed below. Other roles may be assigned with the approval of your faculty advisor as deemed fit for the project. For the entirety of the project, you should communicate progress to your advisor specifically with regard to your role.

- **Before meeting with your team**, take some time to ask yourself: what is my "natural" role in this group (strengths)? How can I use this experience to help me grow and develop more?
- **As a group,** discuss the various tasks needed for the project and role preferences. Then assign roles in the table on the next page. Try to create a team dynamic that is fair and equitable, while promoting the strengths of each member.

Communication Leaders

Suggested: Assign a team member to be the primary contact for the client/sponsor. This person will schedule meetings, send updates, and ensure deliverables are met.

Suggested: Assign a team member to be the primary contact for the faculty advisor. This person will schedule meetings, send updates, and ensure deliverables are met.

Common Leadership Roles for Capstone

1. **Project Manager:** Manages all tasks; develops an overall schedule for the project; writes agendas and runs meetings; reviews and monitors individual action items; creates an environment where team members are respected, take risks, and feel safe expressing their ideas.
   Required: On Edusourced, under the Team tab, make sure that this student is assigned the Project Manager role. This is required so that Capstone program staff can easily identify a single contact person, especially for Purchasing and Receiving project supplies.
2. **Logistics Manager:** coordinates all internal and external interactions; leads in establishing contact within and outside of the organization, following up on communication of commitments, obtaining information for the team; documents meeting minutes; manages facility and resource usage.
3. **Financial Manager:** researches/benchmarks technical purchases and acquisitions; conducts pricing analysis and budget justifications on proposed purchases; carries out team purchase requests; monitors team budget.
4. **Systems Engineer:** Analyzes client initial design specification and leads establishment of product specifications; monitors, coordinates, and manages the integration of sub-systems in the prototype; develops and recommends system architecture and manages product interfaces.
5. **Test Engineer:** oversees experimental design, test plan, procedures, and data analysis; acquires data acquisition equipment and any necessary software; establishes test protocols and schedules; oversees statistical analysis of results; leads presentation of experimental findings and resulting recommendations.
6. **Manufacturing Engineer:** coordinates all fabrication required to meet final prototype requirements; oversees that all engineering drawings meet the requirements of machine shop or

vendor; reviews designs to ensure design for manufacturing; determines realistic timing for fabrication and quality; develops schedule for all manufacturing.

Team Member	***Role(s)***	***Responsibilities***
Akshara Rajesh	Project Manager	✔ Develop a schedule for the team ✔ Review individual action items ✔ Make sure everyone understands what is going on
Peter Nguyen	Financial Manager	● Carries out purchase requests from the team ● Makes sure the team is staying within budget with purchase request
Quinton Jones	Logistics Manager	● Ensures that the team has meeting times documented ● Ensures that information will be gathered for the team ● Ensure that resourced usage is sufficient
Ava Shilling	Systems, Test, and Manufacturing Engineer	- Oversee experimental design and testing - Manage product to meet final prototype requirements

Step 5: Agree to the above team contract

Team Member: Peter Nguyen *Signature:* 

Team Member: Akshara Rajesh *Signature:* 

Team Member: Quinton Jones *Signature:* 

Team Member: Ava Shilling *Signature:* 

References

Provide a numbered list of all references in order of appearance using APA citation format. The reference page should begin on a new page as shown here.

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