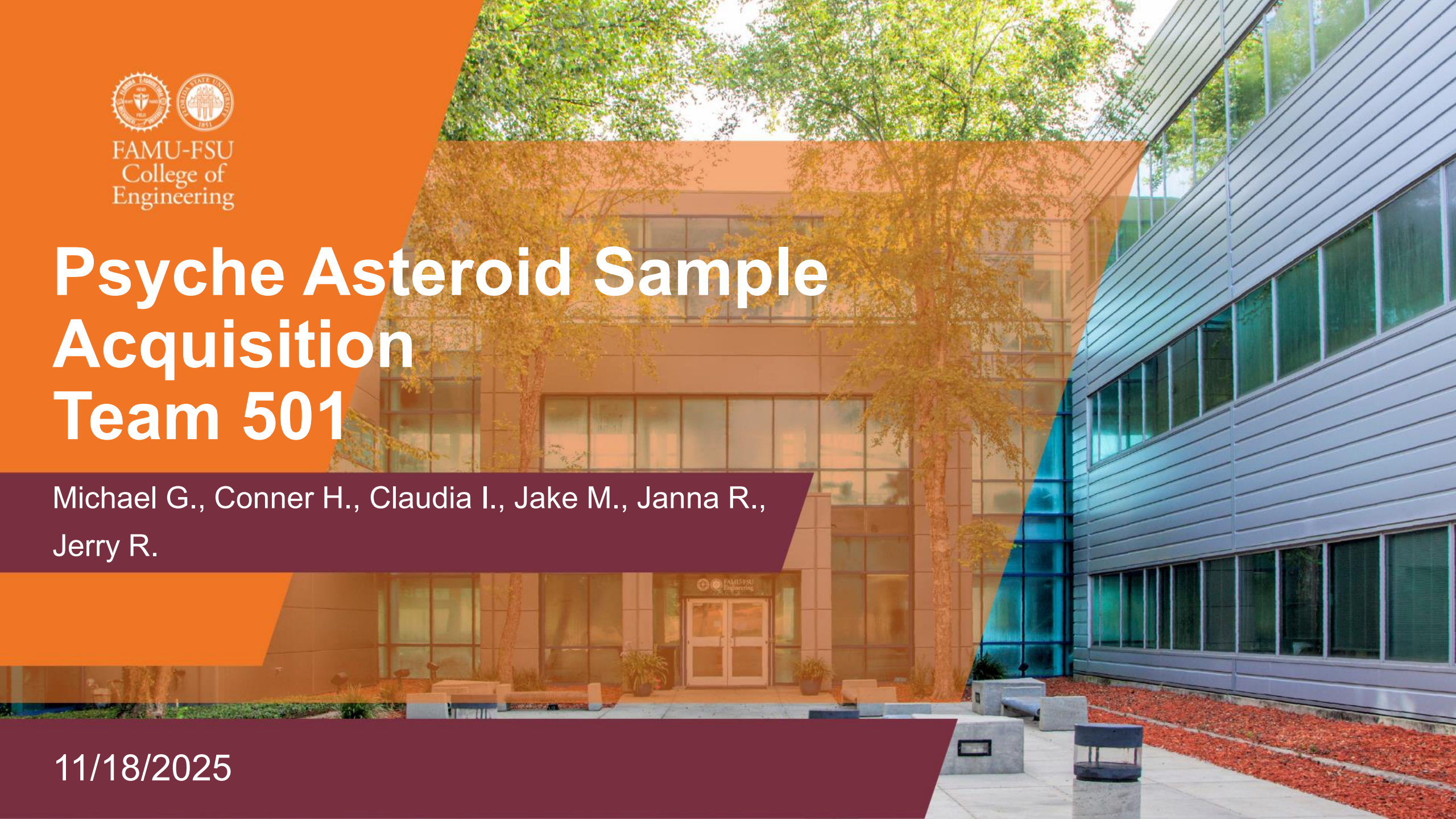

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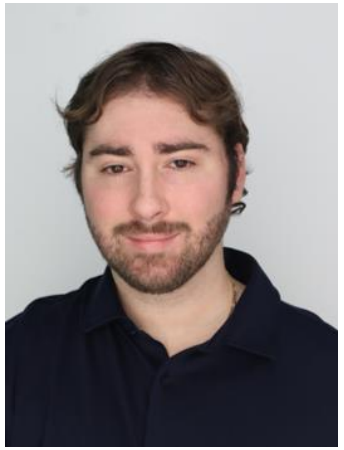
Psyche Asteroid Sample Acquisition Team 501

Michael G., Conner H., Claudia I., Jake M., Janna R., Jerry R.

11/18/2025

Team 501: Introductions



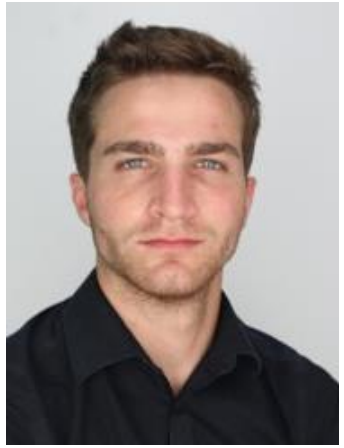
Michael Gregory
Mechanical Engineer

Jake Marcus
Design Engineer
Presenter

Claudia Irausquin
Materials Engineer

Janna Rhodes
Test Engineer
Presenter

Conner Holmes
Robotics Engineer



Jerry Richardson
Systems Engineer
Presenter

FAMU-FSU College of Engineering

Sponsor and Advisor

Dr. Cassie Bowman

Project Sponsor

PSYCHE NASA ASU Arizona State University

Dr. Shreyas Balachandran

Faculty Advisor

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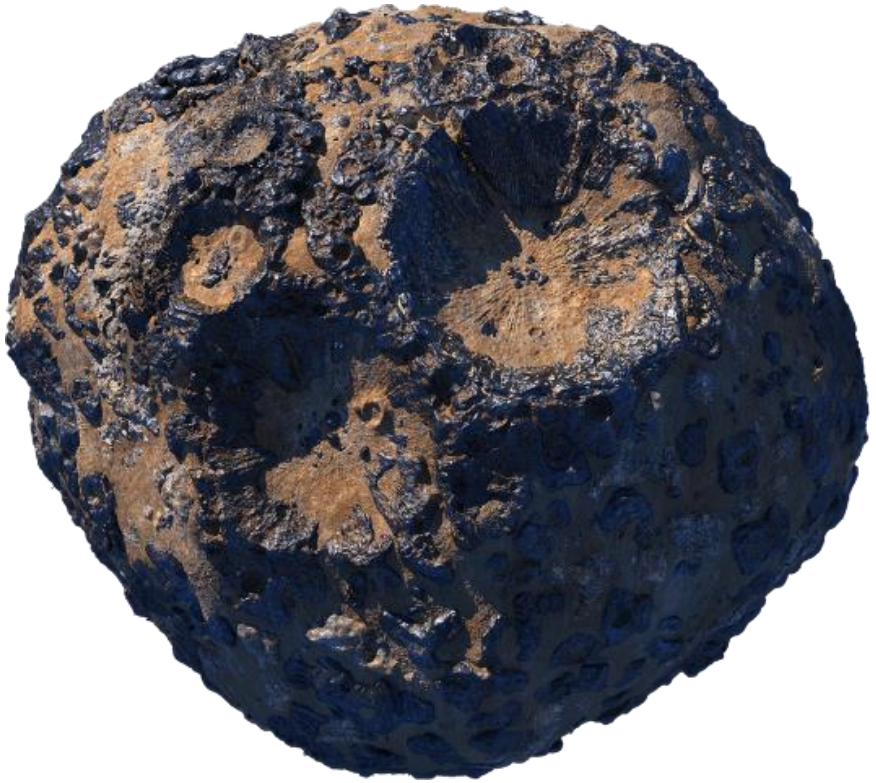
Richardson



NASA Rendering of Asteroid (16) Psyche

Objective

The objective of this project is to acquire and cache samples across multiple surface types on asteroid (16) Psyche. This effort is coordinated with Team 502, who is focused on sample retrieval.

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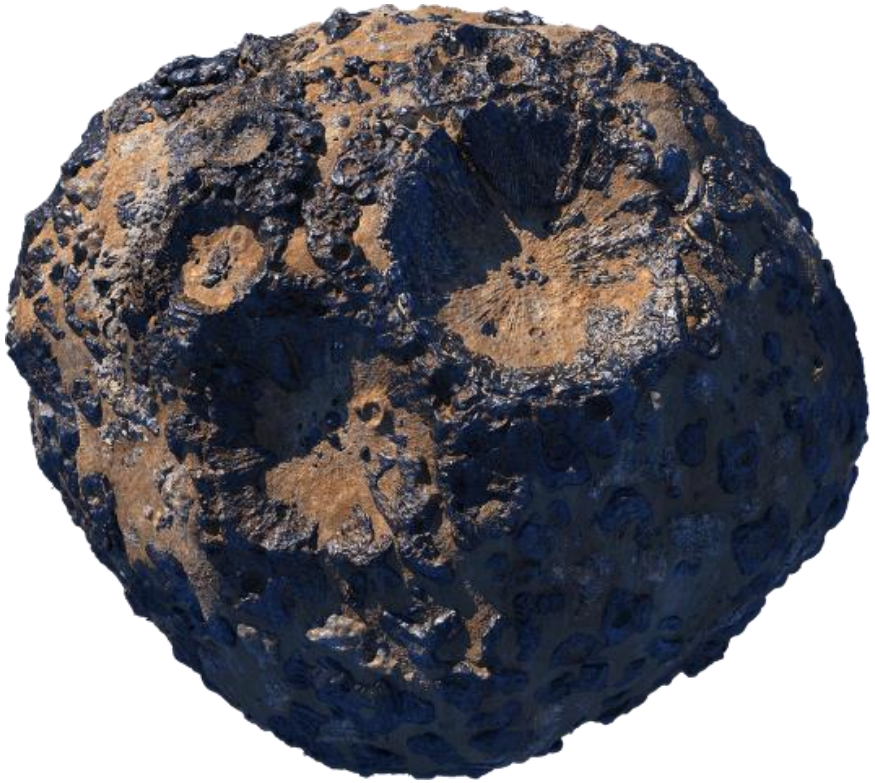
Richardson

Background

- Psyche is believed to be an exposed core of an early planetesimal.
- Hypothesized metal composition of iron-nickel and silicates.
- Located in the asteroid belt.
- Rocky outer layer from collisions occurring billions of years ago.
- Spacecraft sent by NASA in 2023 will arrive in 2029 to observe Psyche's surface.



NASA Rendering of Asteroid (16) Psyche

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Project Overview

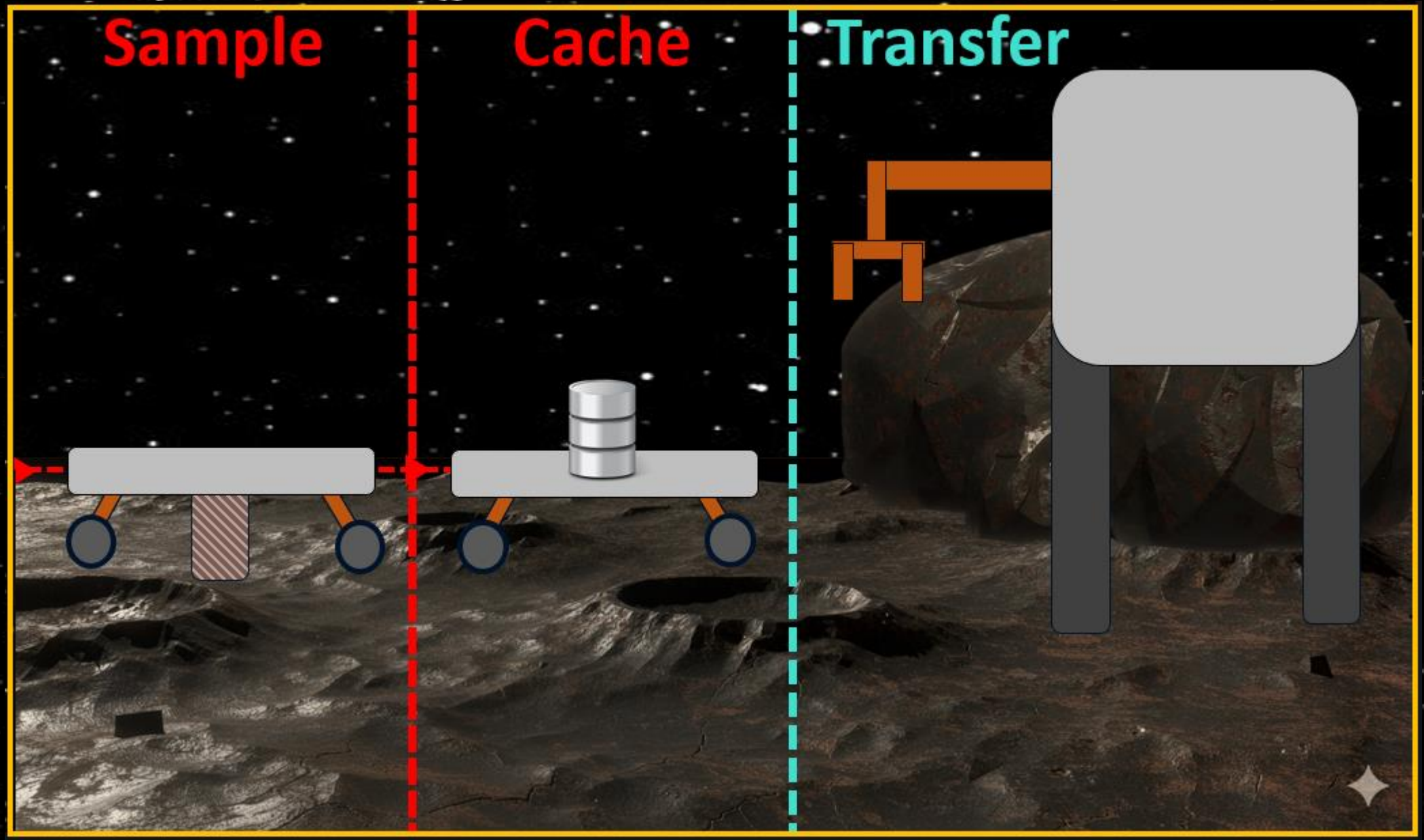
Assumptions

- Sampling system is on host of our choice
- Host begins on asteroid
- Host safely traverses to extraction points

Customer Needs

- Compatible for a handoff to T502
- Take multiple samples
- Keep the integrity of samples

Critical Functions:



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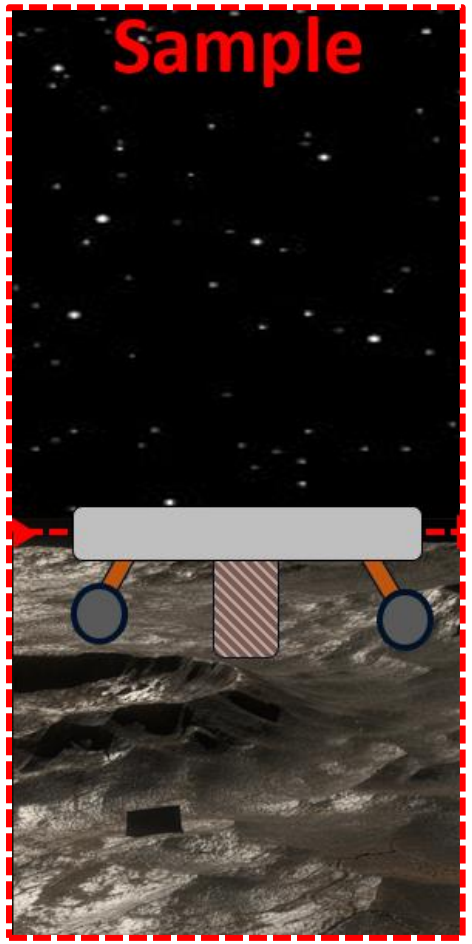
Critical Targets



Function	Metric	Target
Extract Samples	Quantity (# of samples) Volume (cm^3)	8 samples 9 cm^3
Collect Variety of Samples	Quantity	2 samples
Stabilize	Sum of opposing forces	<50N

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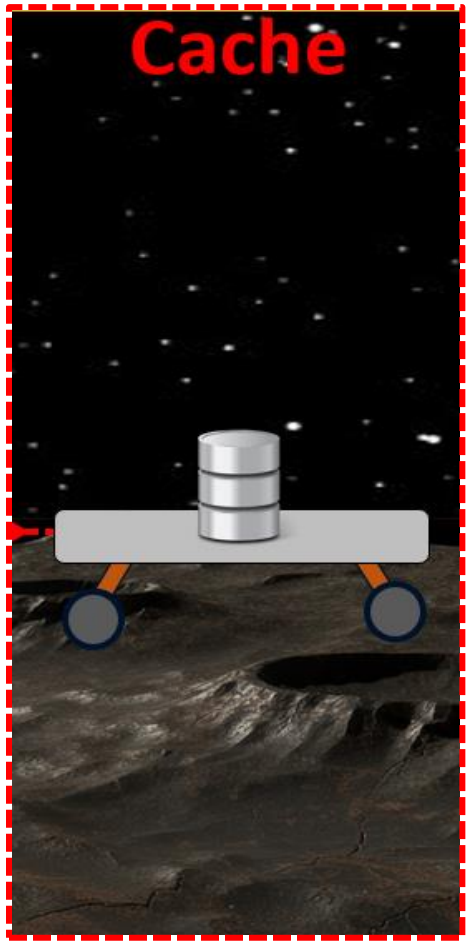
Critical Targets



Function	Metric	Target
Store Samples	Quantity	10 samples
Protect Samples	Quantity	9 samples
Measure Amount Extracted	Accuracy percentage (%)	±10.0%

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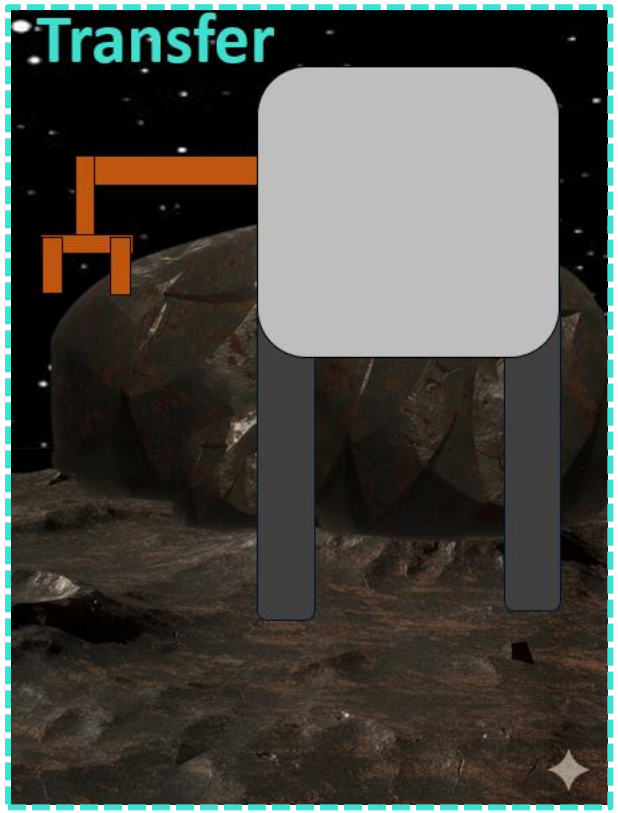
Critical Targets



Function	Metric	Target
Transfer Contents to T502	Accessibility angle	360°

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Additional Targets

Function	Metric	Target
Automate Process	Steps requiring intervention	≤1
Prevent Cross Contamination	Carryover percentage(%)	<5%
Temperature Resistance	Temperature range in Kelvin (K)	100K-200K

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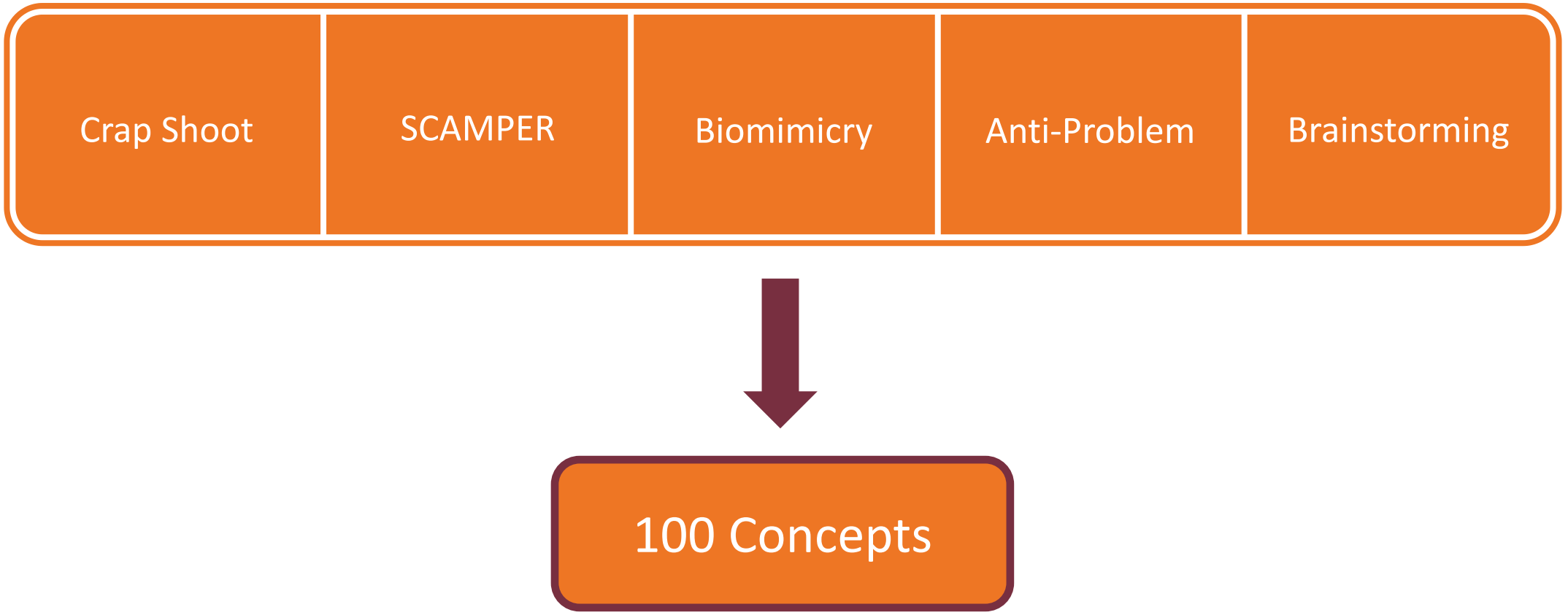
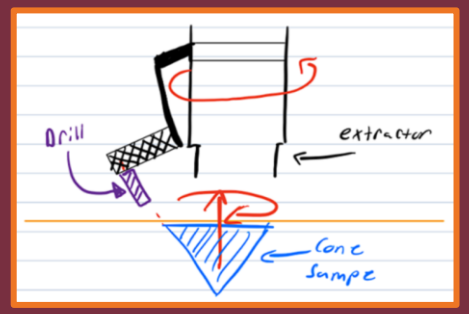
Concept Generation Tactics



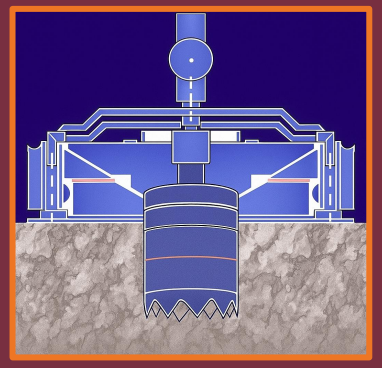
Medium Fidelity Concepts

Grinding Capsules



Conically Rotating Drill-Bit

Laser Coring



Corer with Gas Blast

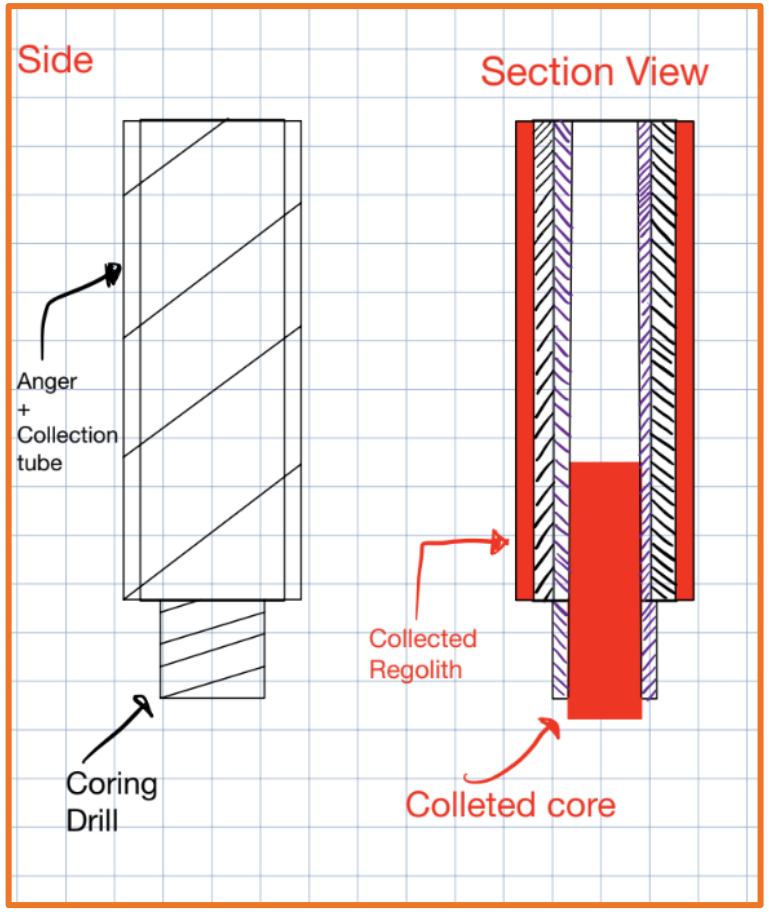
Cone Grinder

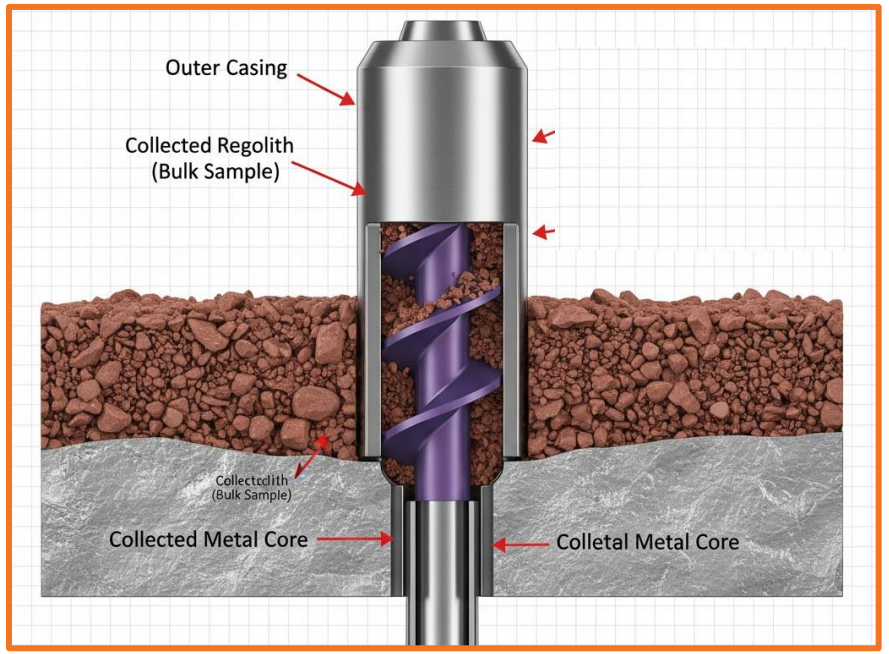
High Fidelity

- Auger Corer
- Semi-Portable Trepanner
- Ultrasonic Drill

High Fidelity

- Auger Corer
- Semi-Portable Trepanner
- Ultrasonic Drill

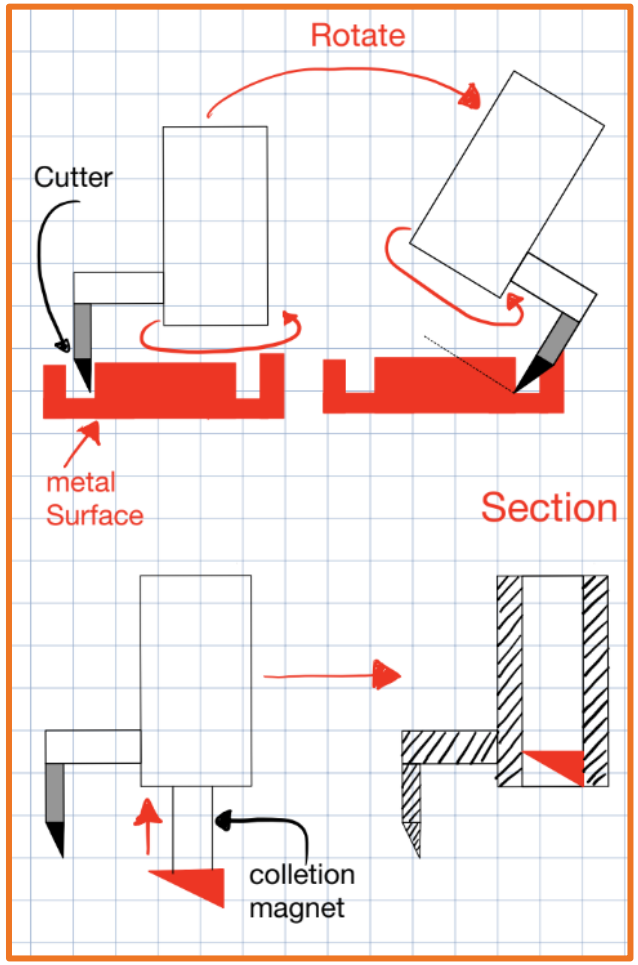




Gemini Generated Image

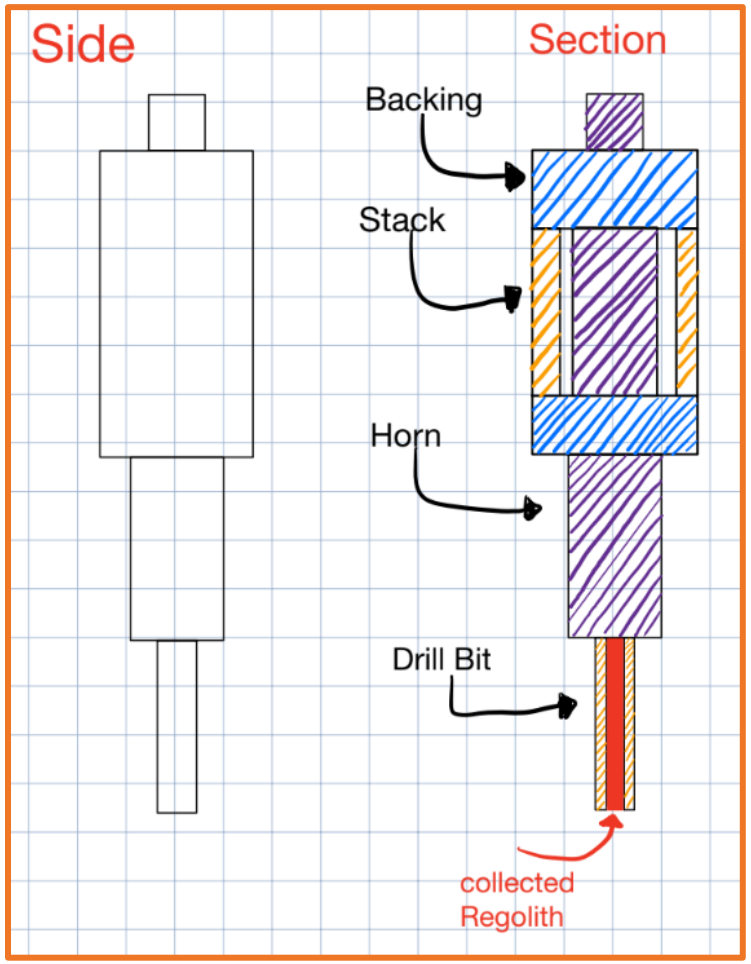
High Fidelity

- Auger Corer
- Semi-Portable Trepanner
- Ultrasonic Drill



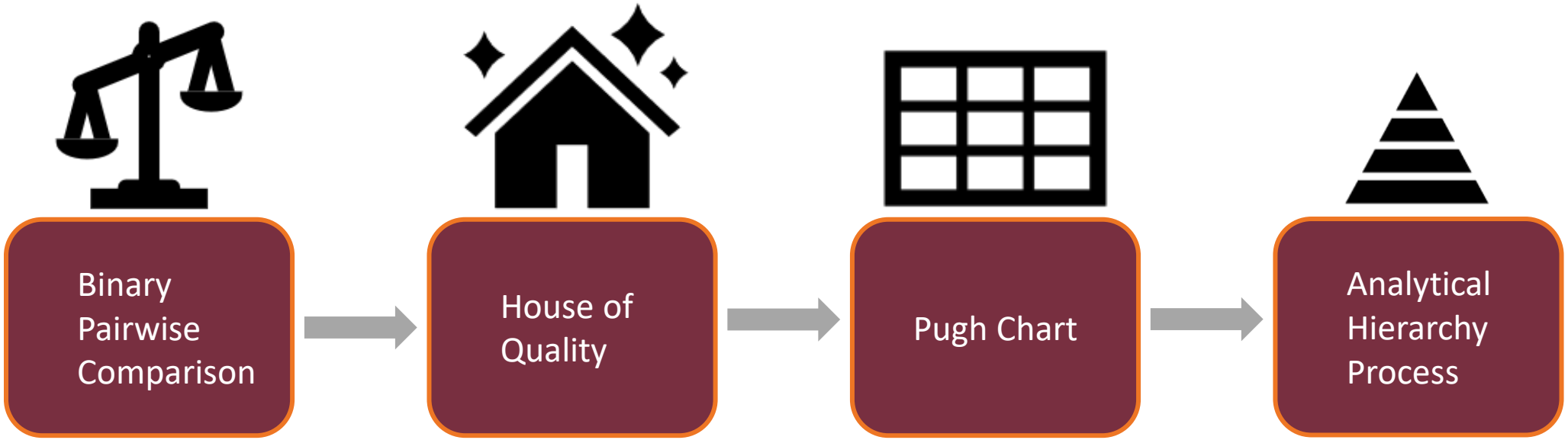
High Fidelity

- Auger Corer
- Semi-Portable Trepanner
- Ultrasonic Drill



Gemini Generated Image

Concept Selection Process



Binary Pairwise Comparison

Customer Needs	Score
Cache is compatible for handoff	1
System is automated	1
Sampler obtains surface and subsurface material	4
Cache maintains sample integrity	4
Sampler acquires multiple sample types	4

House of Quality

Engineering Characteristic	Ranking
Structural Integrity	1
Cache Size	2
Total Steps Required for Process	3
Depth of Sample	4
Quantity of Samples	5
Reliability	6
Time of Process	7
Required Counter Force	8
Degree of Sealing	9
Preserves Layering of Subsurface Material	10

Pugh Chart – Iteration 1

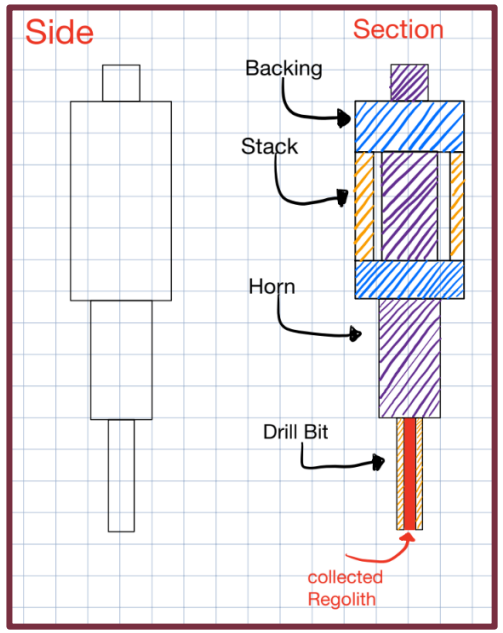
Datum:

Perseverance Rover

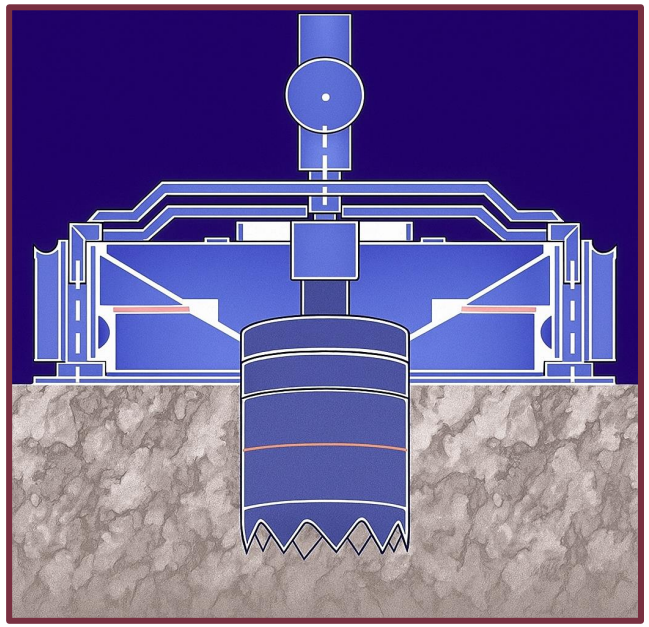
Selection Criteria:

- Steps Taken to Move Sample into Storage
- Sample Stratigraphy
- Time of Process
- Depth of Sample
- Counter Force

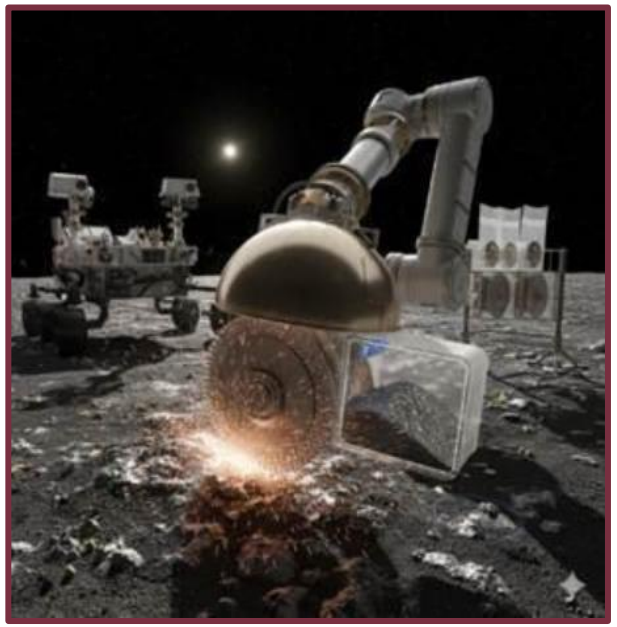
Analytical Hierarchy Chart



Ultrasonic Drill
Alternative Value:
0.180



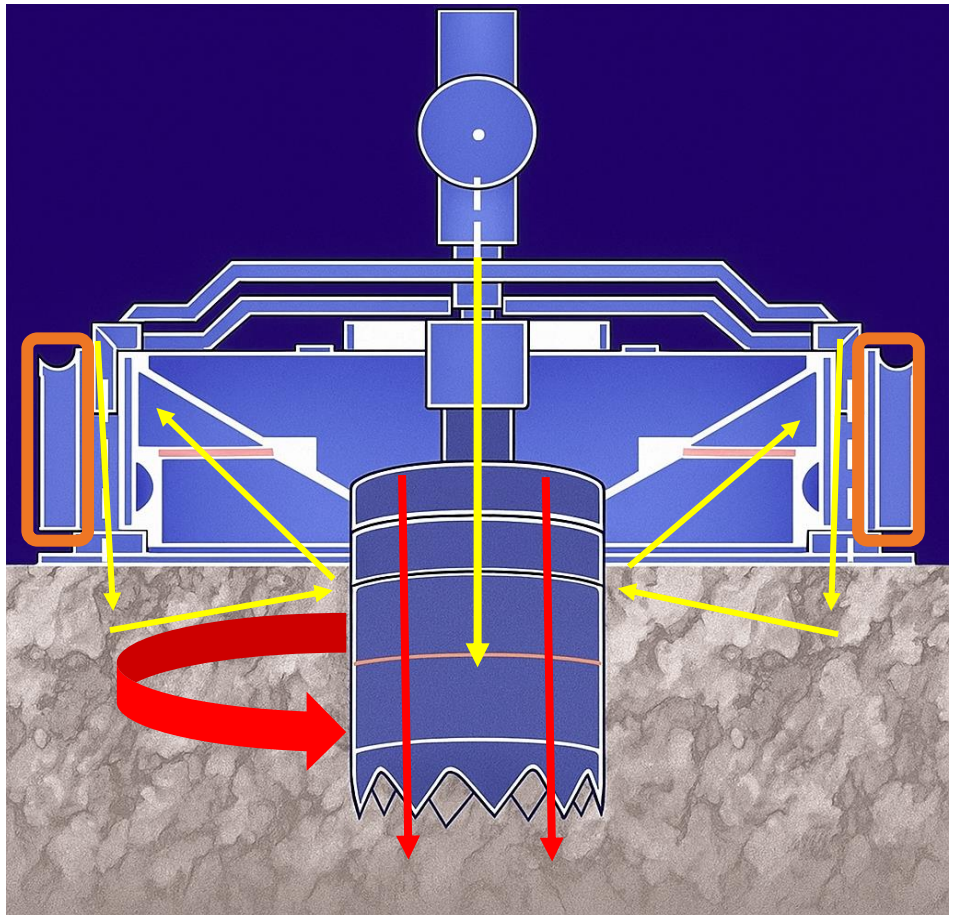
Corer with Gas Blast
Alternative Value:
0.406



Grinding Capsules
Alternative Value:
0.414

Final Concept

1. Gas blast pushes regolith into collection chamber
2. Corer works into hard subsurface material.
   - Thrusters provide necessary counter force.
3. Gas blast pushes grinded material into collection chamber



“Final” Concept: Corer with Gas Blast

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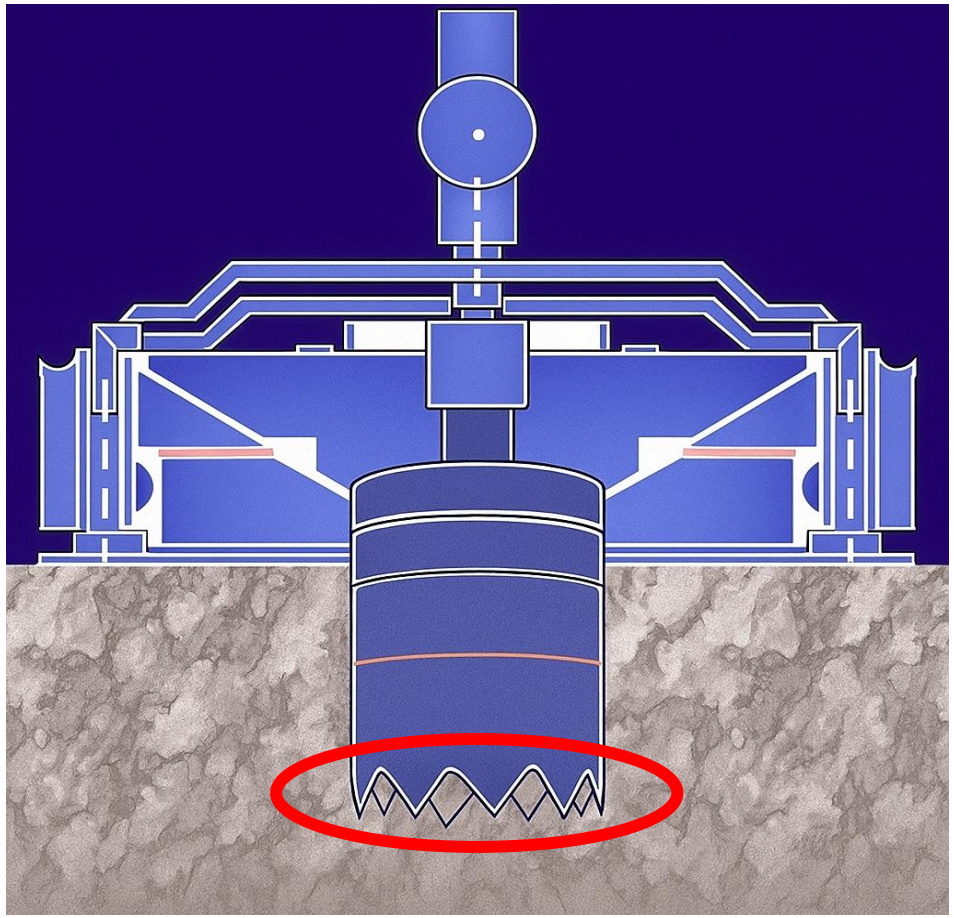
Final Concept Feasibility

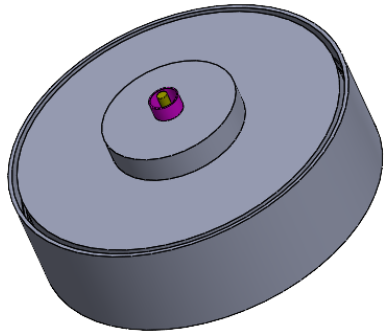
Coring drill bit determined to be impractical

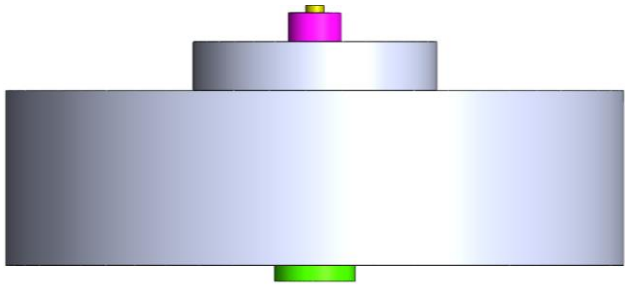
- Issues with core removal
- Adjusted design with a grinding bit to improve project feasibility

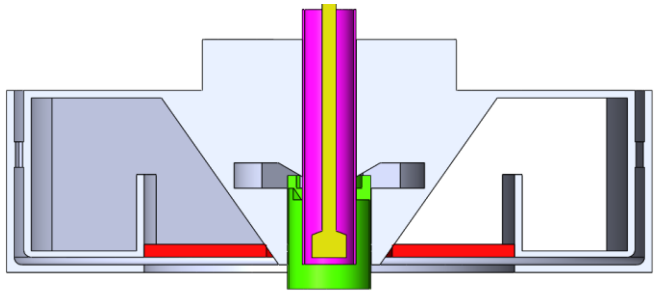


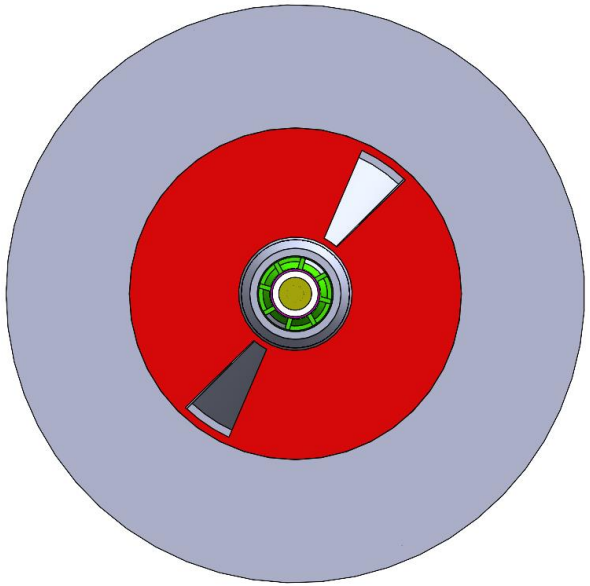
“Final” Concept: Corer with Gas Blast

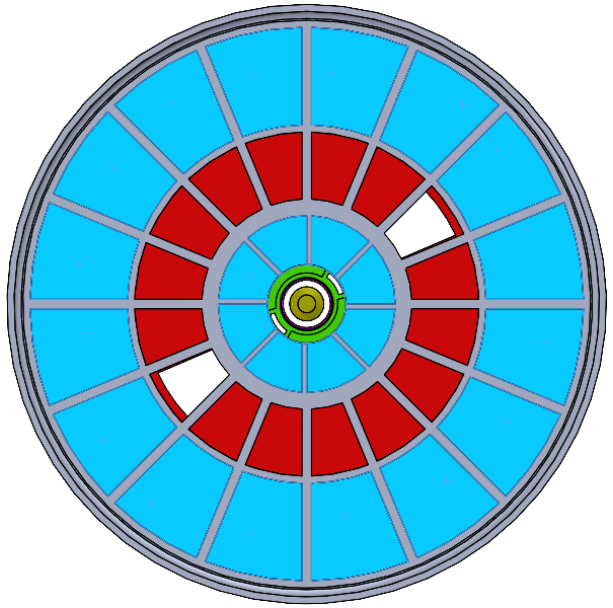
Preliminary Design







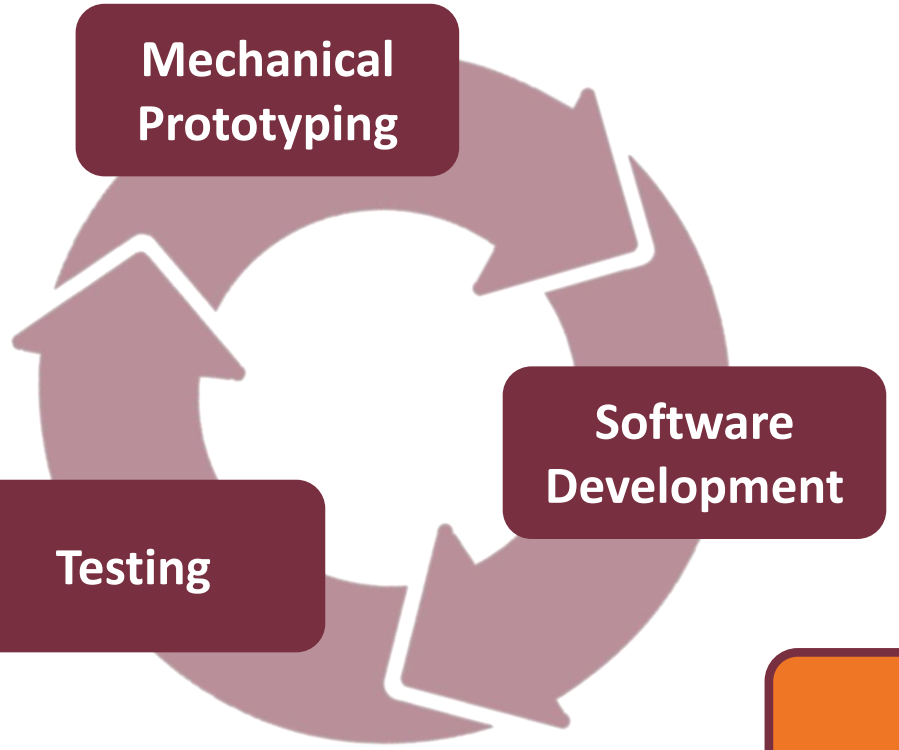




Future Work

Material Selection

Bill of Materials



Final Prototype

Questions?

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Back Up Slides

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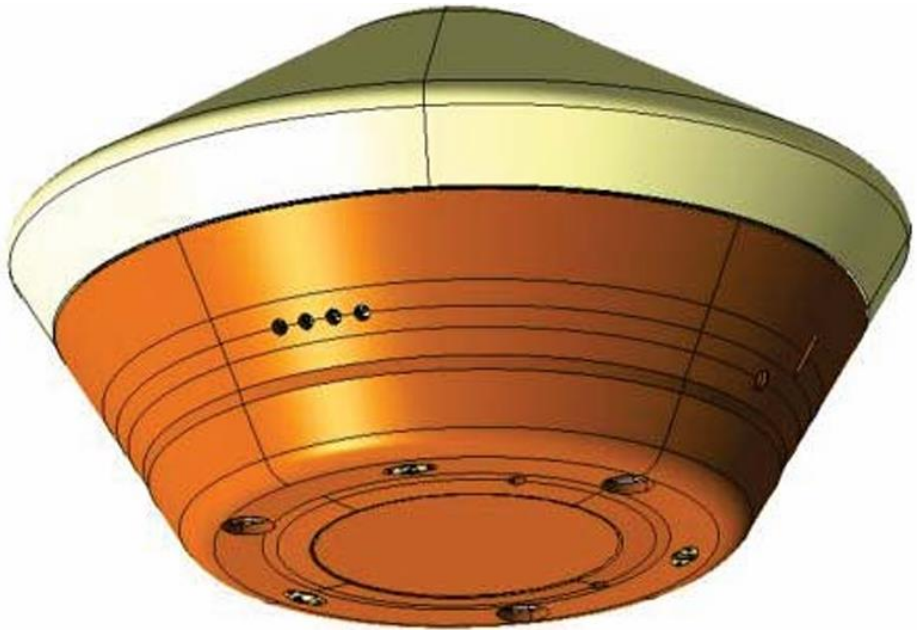
Integrating With T502



OSIRIS-REx: Returning the asteroid sample [PDF]. NASA/Lockheed Martin.

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