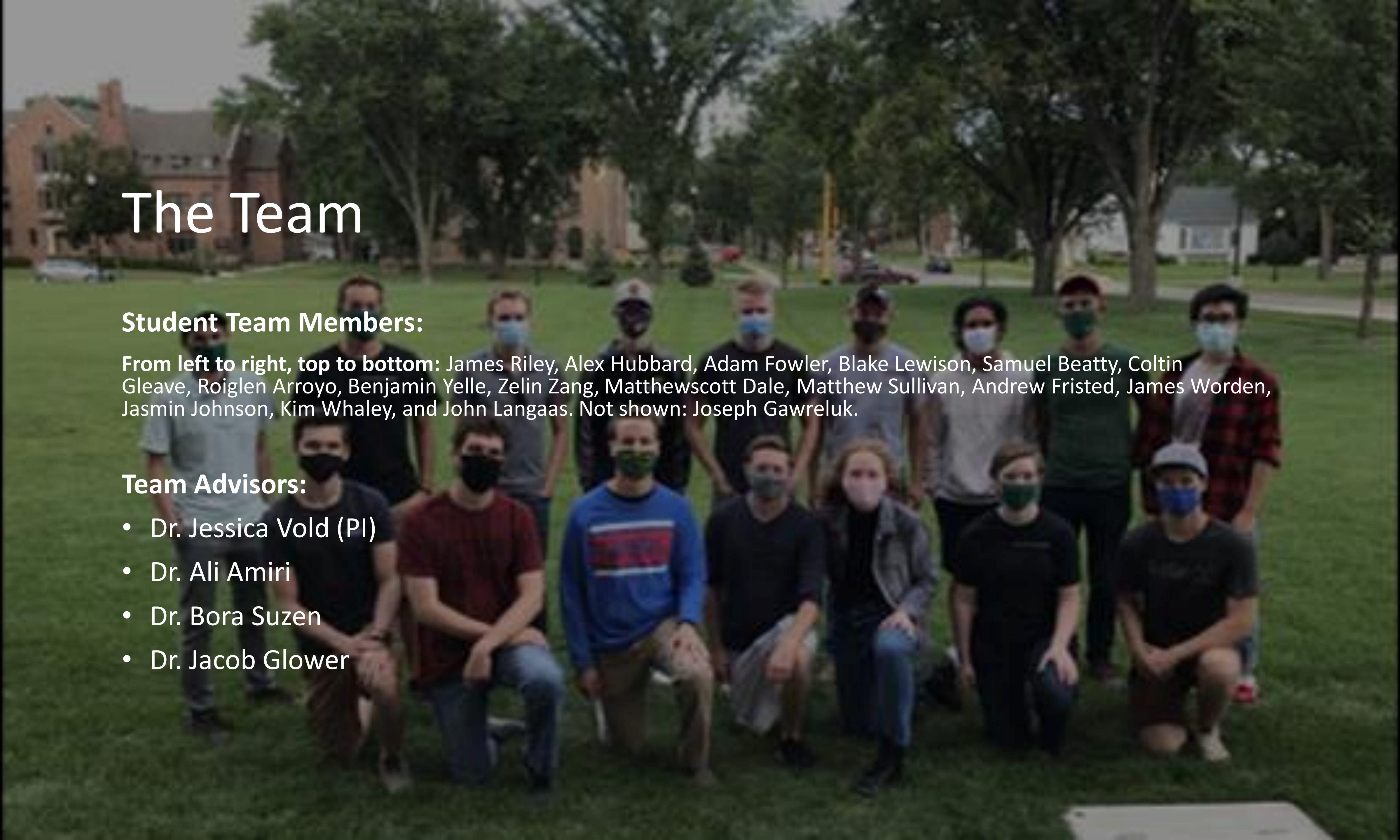
The Pathbuilder Project

Design of a rover for excavation and grading on the lunar surface

Presented by the NDSU X-Hab Challenge Team

Presentation Overview

- Team Introductions
- Objectives of the Pathbuilder Project
- Rover Design Details
- Current Progress
- Questions



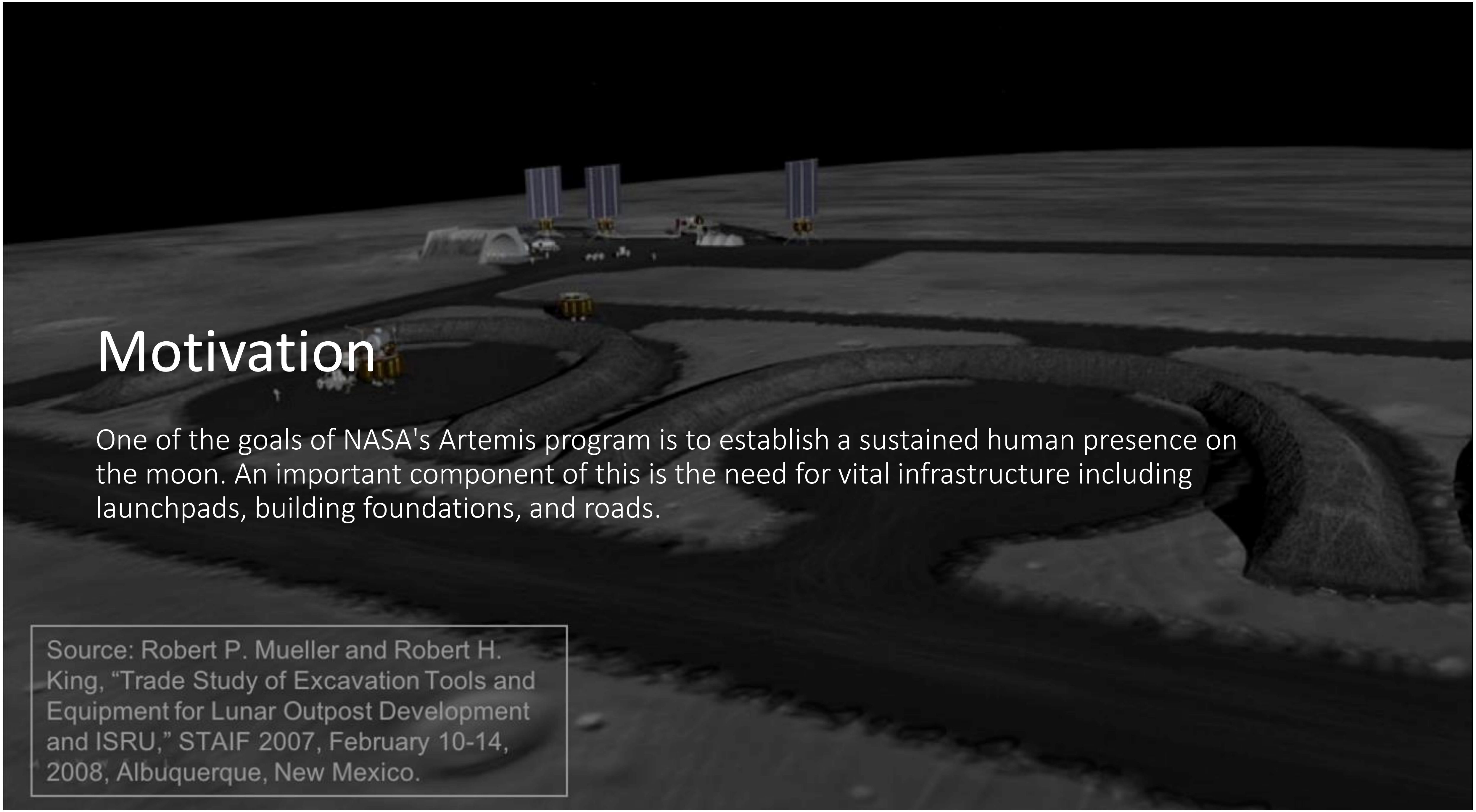
The Team

Student Team Members:

From left to right, top to bottom: James Riley, Alex Hubbard, Adam Fowler, Blake Lewison, Samuel Beatty, Coltin Gleave, Roiglen Arroyo, Benjamin Yelle, Zelin Zang, Matthewscott Dale, Matthew Sullivan, Andrew Fristed, James Worden, Jasmin Johnson, Kim Whaley, and John Langaas. Not shown: Joseph Gawreluk.

Team Advisors:

- Dr. Jessica Vold (PI)
- Dr. Ali Amiri
- Dr. Bora Suzen
- Dr. Jacob Glower



Motivation

One of the goals of NASA's Artemis program is to establish a sustained human presence on the moon. An important component of this is the need for vital infrastructure including launchpads, building foundations, and roads.

Source: Robert P. Mueller and Robert H. King, "Trade Study of Excavation Tools and Equipment for Lunar Outpost Development and ISRU," STAIF 2007, February 10-14, 2008, Albuquerque, New Mexico.

Project Objectives

The Pathbuilder Project is a NDSU capstone project sponsored by the NASA X-Hab Challenge.

The objective of the project was to design and build a prototype of a remotely controlled rover that can create flat, compacted areas on the lunar surface using only solar power. A rover with the ability to create such areas would enable the building of basic lunar infrastructure as well as pave the way for more advanced lunar infrastructure in the future.

The Rover

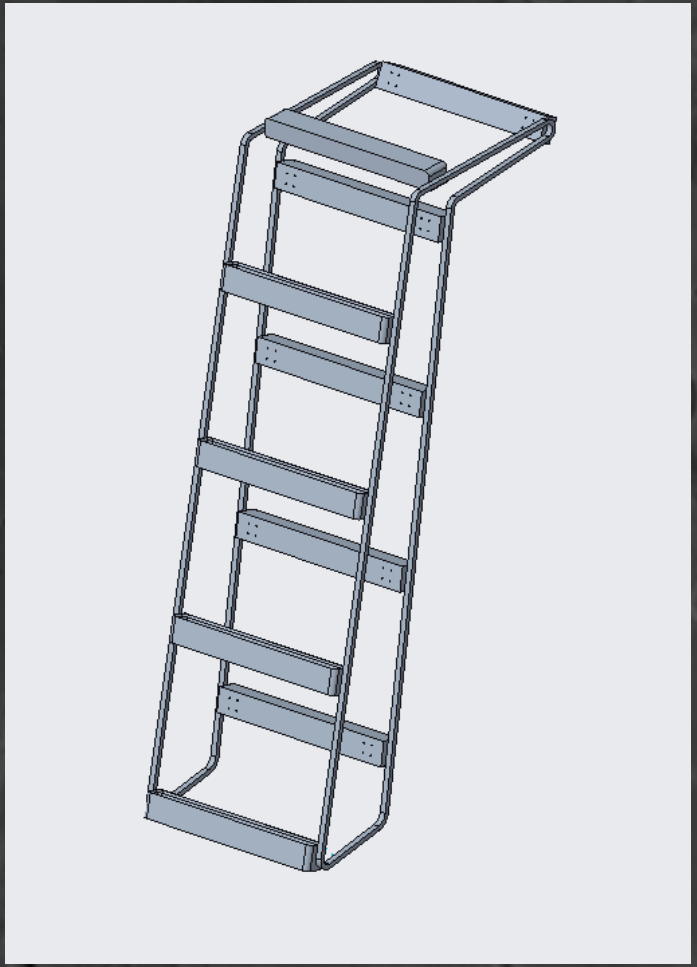
- Frame
- Excavation conveyor
- Regolith hopper
- Compaction roller
- Solar Panel
- Sealed electronics enclosure
- Drivetrain

Excavation Conveyor

Regolith is scooped from the ground with a conveyor belt with buckets.

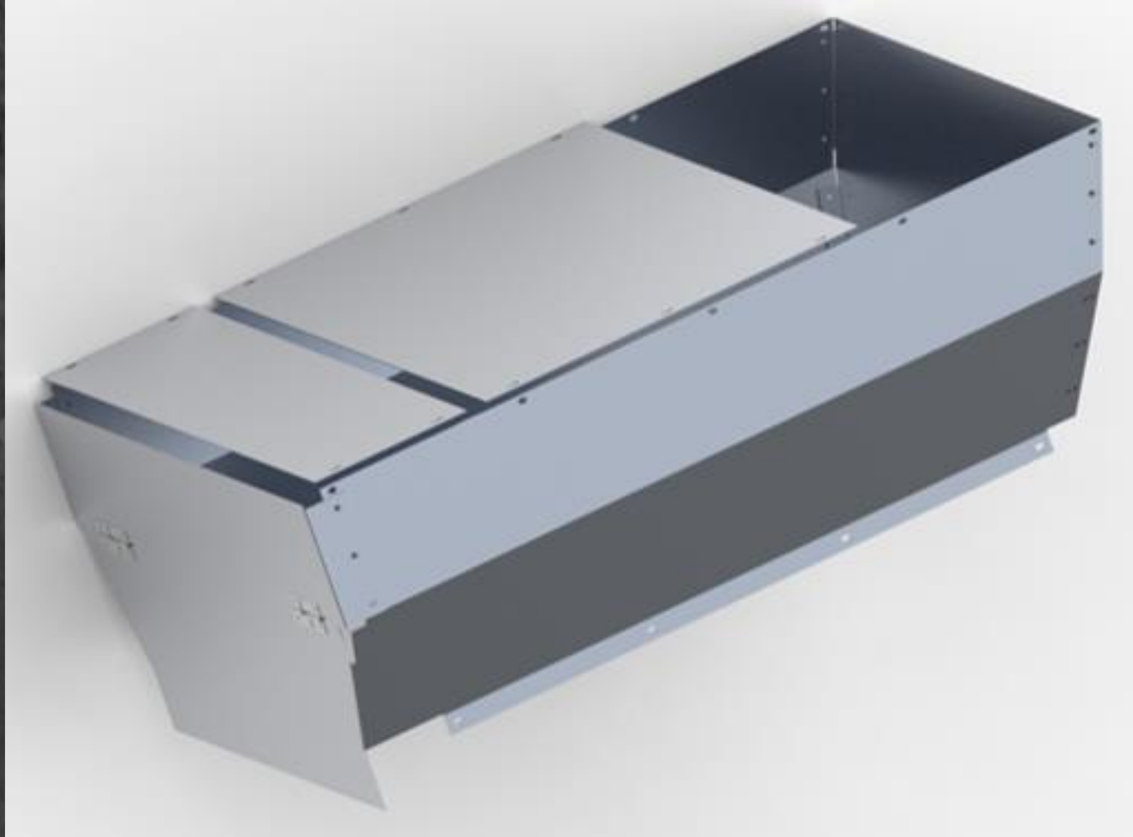
- The conveyor will feed the regolith into a hopper.

- It can be raised or lowered for greater digging depth or for more clearance.



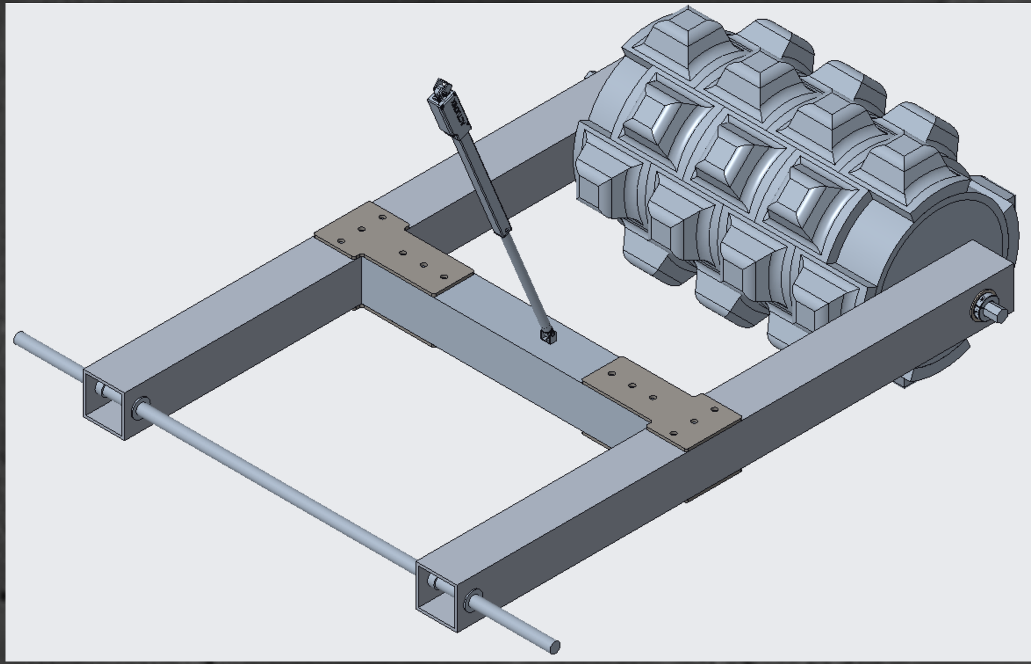
Regolith Hopper

The hopper allows the rover to increase its mass while on the moon. This results in greater compaction while saving mass and fuel at launch



Compaction

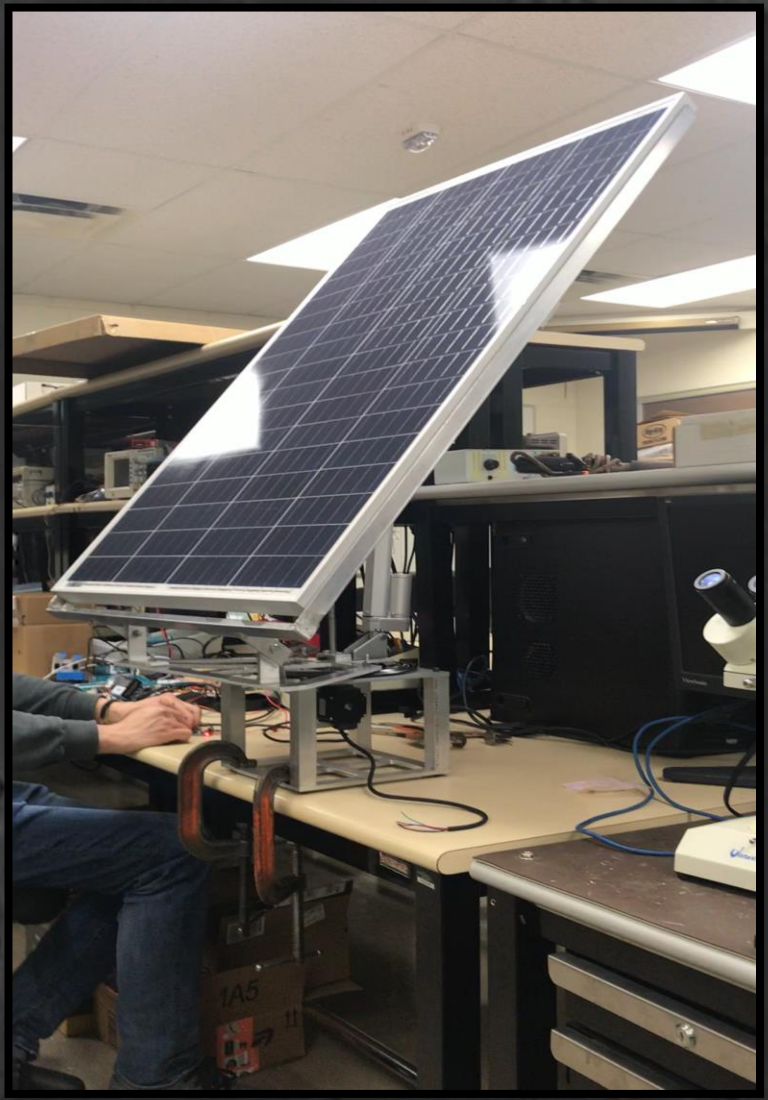
- The roller compacts the regolith
- “Sheepsfoot” protrusions on the drum decrease area of contact between the regolith and roller
- Increased compaction pressure with the hopper and sheep feet yields enough compaction pressure to meet our compaction goal
- Can be stowed away when not in use.



Powering the Rover

Solar Panel Subsystem

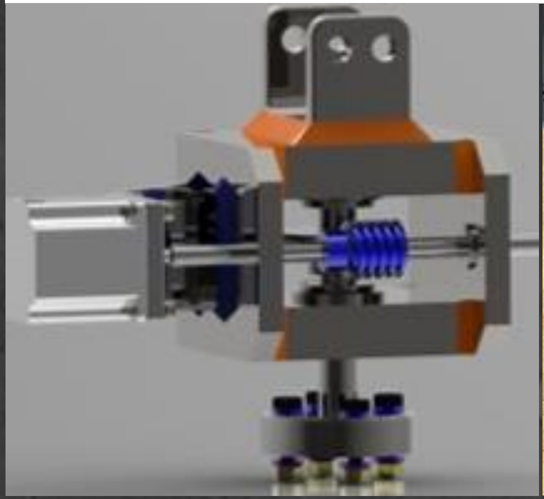
- Maximize Solar Collection
  - Adjust tilt of solar panel to account for slope terrain and longitude
  - Adjust the rotation of the panel to maximize incoming sun
- Dust Removal System
  - Improve the lifespan of the system by delivering periodic air bursts to clean panel.



Driving the Rover

Drivetrain Subsystem

- 4-wheel independent steering
  - Steering driven by a worm gear
- Frame composed of aluminum tubing
- Wheels composed of PVC tubing, 12 in. Diameter
  - Driven by a planetary gearbox
- Machining done at NDSU by the drivetrain team



Fall Semester

During the fall semester, the team completed the design of the rover. Each design step was accompanied by a virtual Design Review with our sponsors at Kennedy Space Center.

Identification of System Requirements (Systems Definition Review)

Conceptual Design (Preliminary Design Review)

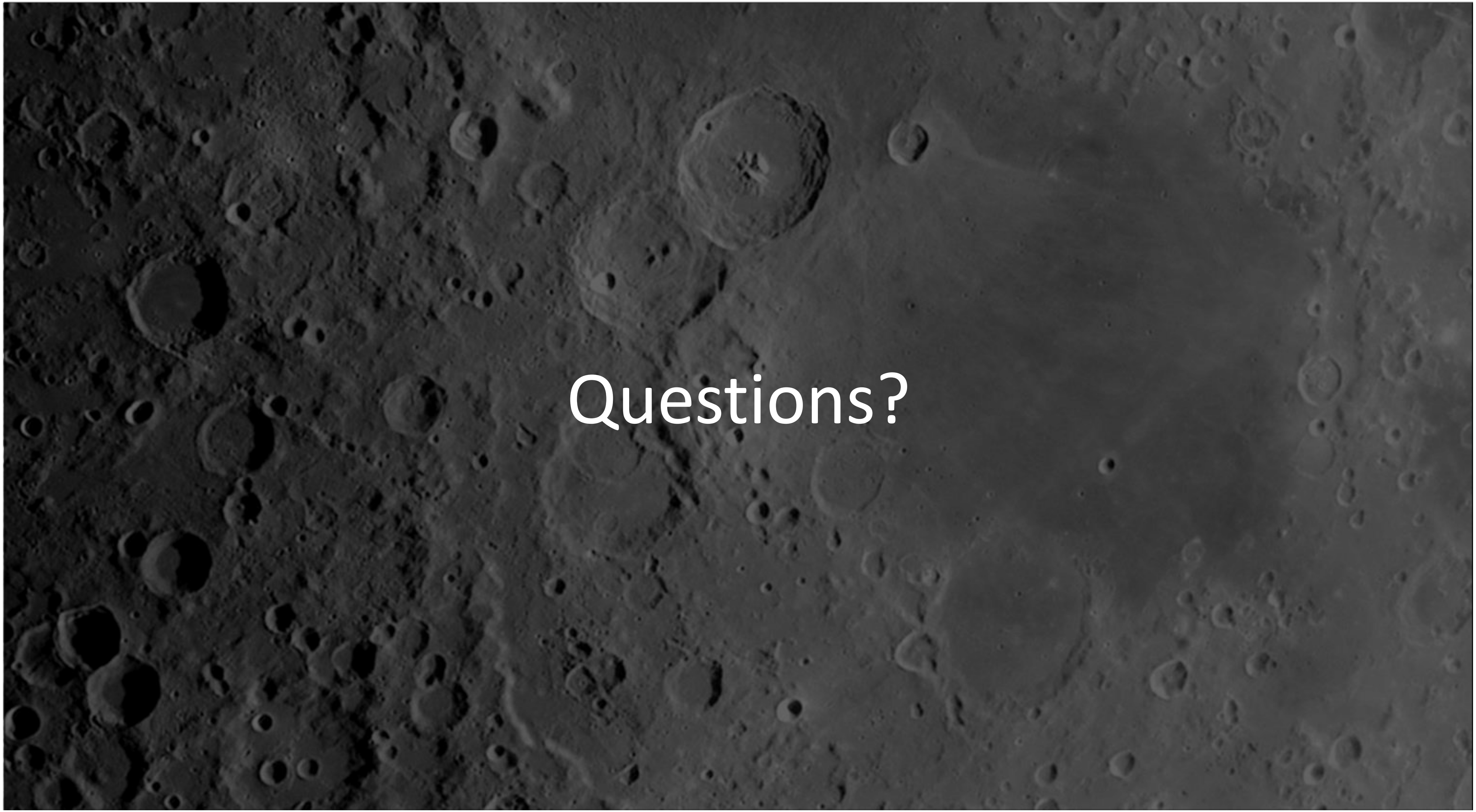
Final Design (Critical Design Review)

Spring Semester

The spring semester has been focused on manufacturing, assembly, and testing of the rover.

Most individual systems have been manufactured, but the rover has not been fully assembled yet.

Once the rover is assembled, we will be testing it in a gravel pit provided by the Innovation Studio in Fargo. The gravel pit is a simple way of testing the rover's key capabilities such as material collection, compaction, drivability, and dust removal.


Questions?