ROADS on Mars

Mission Development Log

The New von Brauns

Our Original Documentation

This slideshow gives the highlights of our investigations.

We strongly encourage judges to have a look at our original documentation. These folders hold our original written notes, pictures, and video clips.

To see our original files, click here.

Choosing Our Name

We are: The New von Brauns

We choose our name based off the well known scientist, mathematician, and engineer, Dr. Wernher von Braun. He was well known for his influence in missile development and made many significant discoveries in rocketry. Von Braun’s dream was space exploration. Only in the 1969, with the moon landing, did his dream come true. We felt he represented our team by showing the dream of the Perseverance Rover. He also represents the desire to learn and create in the field of space.

Our Team

And Our Purpose

Jamie Teed- Team Leader, Mission Development Log Writer, and Video Editor

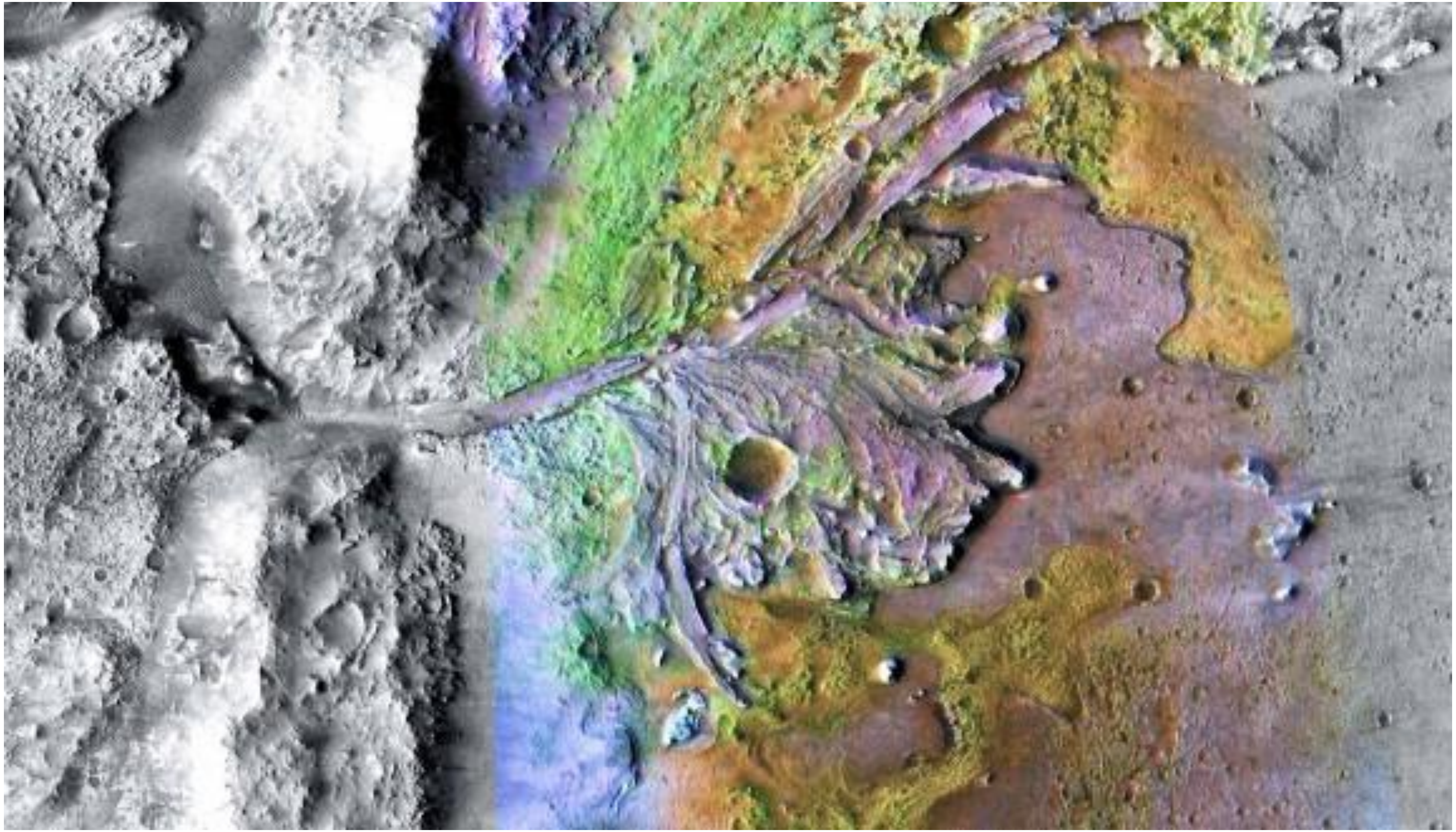
Janina Daep- Search for Life Analyst and Documentation Expert

Noah Williams- Drone Pilot

Aiden Lillibridge- Rover Programmer

Bill Lillibridge- Team Mentor

Landscape Morphology



Delta Dynamics

Figure 1.0

Challenge Criteria

R.O.A.D.S. on Mars Challenge Official Manual Quotations

"In this task, team members will first theorize their own ideas about what might have created the features of Jezero Crater and will then test and will then test their theories."

"The goal is for the team to provide evidence for what they think are the processes responsible for the key feature of the Jezero Crater."

Background: Research

“Analysis of topography and images reveals that the stratigraphically lowest layers within the fan have shallow dips (<2°), consistent with deltaic bottom sets, whereas overlying strata exhibit steeper dips (~2–9°) and downlap, consistent with delta foresets. Strong clay mineral signatures (Fe/Mg-smectite) are identified in the inferred bottom sets, as would be expected in the distal fine-grained facies of a delta.

Our results indicate that Jezero Crater contains exceptionally well-preserved fluvio-deltaic stratigraphy, including strata interpreted as fine-grained deltaic bottomsets that would have had a high potential to concentrate and preserve organic matter (sciencedirect.com).”

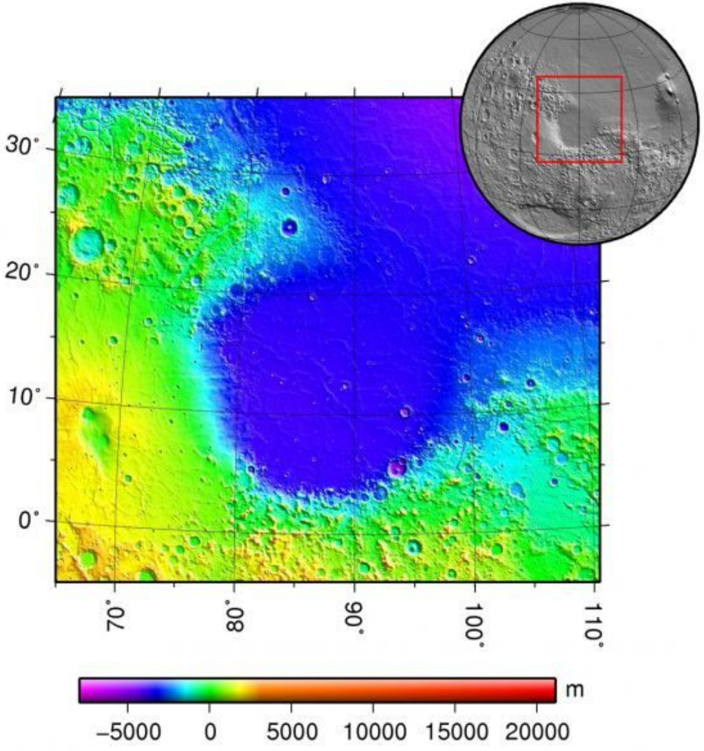


Figure 1.1

Background Research

According to our research, the Jezero Crater formations were made by a river breaking over the crater wall into a pre existing body of water. The body of water was most likely a lake that was located at the bottom of the crater.

This brings a lot of information to our experimentation strategy. We know that our water table must have a "lake," this is an independent variable that we did not anticipate. However, our team believes it will yield the best results.

Another valuable piece of information that this research provided, was the insight into why NASA would choose this location. One of the key ingredients for life is water. Experts have concluded that water is the likely cause for this formation. If the landform was created by water erosion, that means that at one time, the planet had a better atmosphere, temperature, and climate than it has today. If water existed, than the climate was stable enough to support not only the volatile liquid, but even life. That is why this location is so important; it could hold evidence of past life.

Background: Research

Through scientific documentation, we began to form an idea of how the fan was formed. However, we wanted to further our research and develop a greater understanding of how water erosion works. To improve our knowledge, our team visited the place where Tammany Creek meets the Snake River. In *Figure 3,* one can see where the Tammany Creek exits into the river. The fan formation around the river's edge is the feature we visited.

Figure 1.2

Background: Delta Trip

The formations of the creek revealed many insights into the possible causes for the fan. When we arrived at the creek, we noticed many water lines that are caused by changing water levels throughout the year. The particular detail that stood out to us was the shelf-like patterns created at these water level lines. It indicated that the fast water would deposit sediment due to a rapid deceleration caused by the slow river water. When the creek water contacted the river, the creek water dropped the sediment it was carrying because of the sudden loss of momentum.

Figures 1.3-1.6

Delta Trip

Hypothesis

This was our original hypothesis:

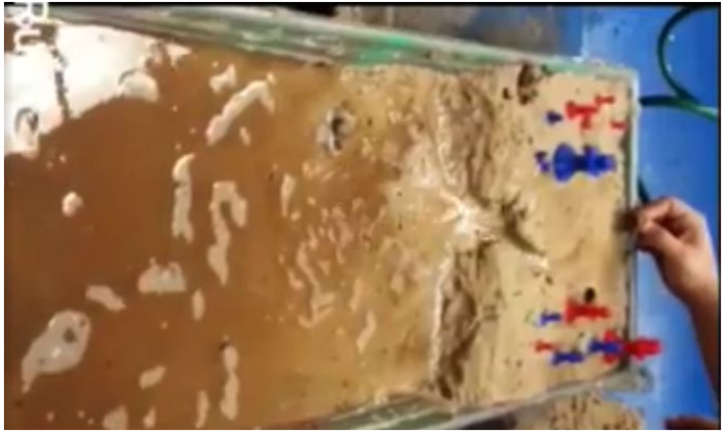
After extensive research on erosion and alluvial fans, it is our theory that the Jezero Crater's unique formation is a result of a continual slow stream of water with occasional flash floods. This would explain the multiple "steps" and different stream impressions and the minimal damage to the crater wall.

If the Jezero Crater was created by a fast stream of water and a lake then our erosion table should have the shelf like the feature because of the deposition of sediment slowing as it hits the slower water.

The different levels and slopes would also be explained by the Crater holding water determining how high the fan steps are. We believe that in order for this sediment to settle into these steps, we will need to have it lead into a pool of water. The faster water meeting the stagnant water should cause the drop of sediment, thus creating the fan formation.

We predict that a shallow slope should give us an accurate result. The water will be moving out of a small hose, so it should have enough momentum to flow through the stream table efficiently






Experimentation

Experiment Details: Materials

Materials:

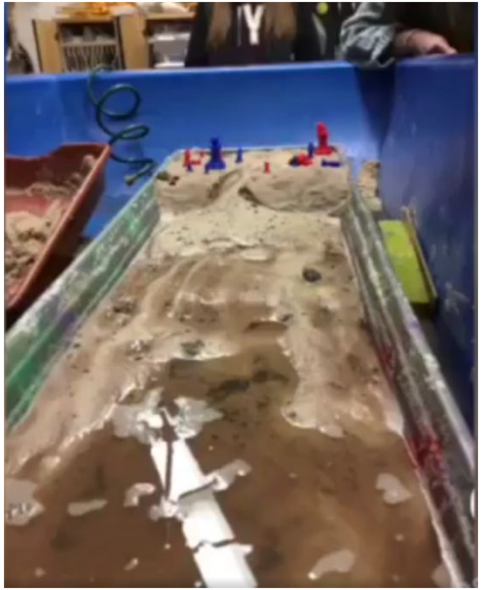
1. Plastic container 1x3 feet
2. Large blue trough
3. 2x4 wooden boards
4. Dry sand and wet sand packed into the plastic container
5. Rulers, trowels, spatulas
6. Small plastic chess pieces
7. A small hose that attaches to a nearby sink
8. An assortment of different sized rocks ranging to the size of gravel
9. Buckets nearby

Experiment Details: Procedure

1. Place the plastic container in the large blue trough.
2. Put the 2x4 wooden boards under the plastic container to get the desired elevation at one end (approximately 2-degree elevation).
3. Place wet sand packed into the bottom of the plastic container, use dry sand on the top. Make sure to add the different sized rocks in a variety of places.
4. Make the crater wall using the sand to build a cliff of three to four inches, this can be done using the rulers, trowels, and spatulas as tools.
5. Add the small plastic pieces on the flat top of the crater (not the lake part)
6. Fill the bottom of the crater with water until there is at least a half-inch of standing water.
7. Attach the small hose to the sink and line the end parallel with the flat top of the crater, pointing to the lake.
8. Turn on the hose to desired streamflow
9. When the experiment is done, use the bucket nearby to carefully drain the water and make observations of the sand formations.

Experiment Description

With any experiment, one learns what methods work best to yield the best results. Some improvements we had to make were:

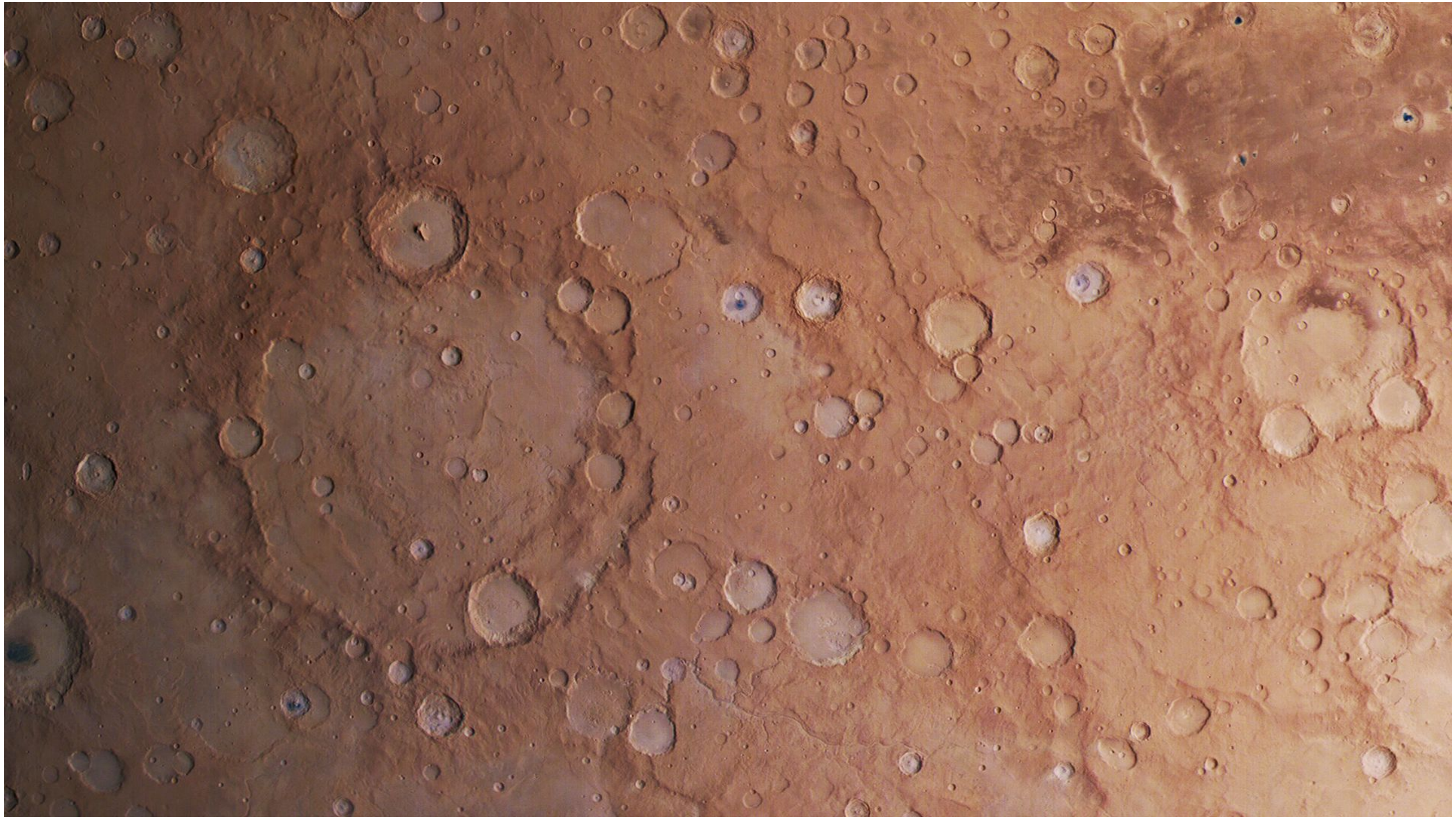


- The plastic pieces cannot be placed in the lake because they float, to compensate for lack of obstacles we added more rocks in a random pattern.
- We found the water gets very murky, so the only way to see the formation is to drain the water. However, it has to be done slowly and carefully so not to disturb the formation below.

Analysis

Even though our first experiments were flawed, they ultimately led us to refine our thinking and rule out other methods of formation. Such as the heavy water flow creating too much erosion and sweeping the debris out in a different pattern. With a combination of slow water, a gradual slope, the crater wall breaking, different types of sediment, and a standing body of water below, our experiments replicated the crater formations closely. We noticed that the sediment created from the river and the crater wall erosion distributed at different places. The fan shape was created by this sediment deposition when the faster water met the static water causing the water to drop the dirt at one spot.

We can conclude from our research and data that the Jezero Crater Fan was created by a steady stream flowing off the crater wall, breaking the side, and flowing into a preexisting lake. And when the water slowed, the sediment dropped and created the prominent features on the surface today. This theory not only supports most of our hypothesis but the latest data of the Jezero Crater.



Crater Formation

Figure 2.0

Challenge Criteria

R.O.A.D.S. on Mars Challenge Official Manual Quotations

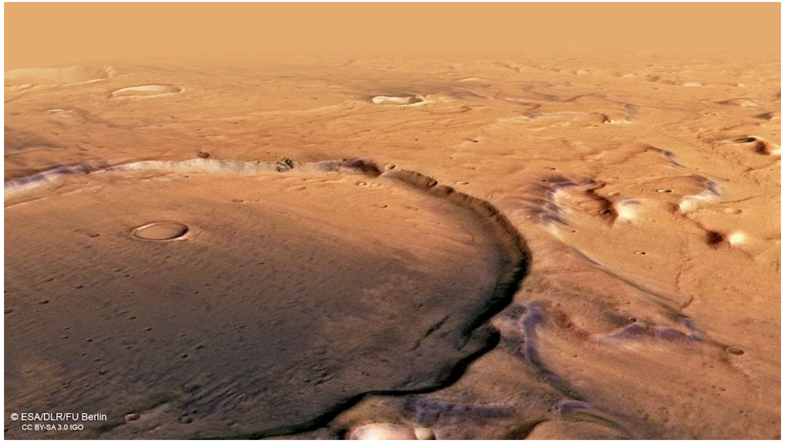
"This part of the challenge asks team members to consider:

- How do craters form?
- Can crater formation provide insight into processes that shaped other objects in the solar system?

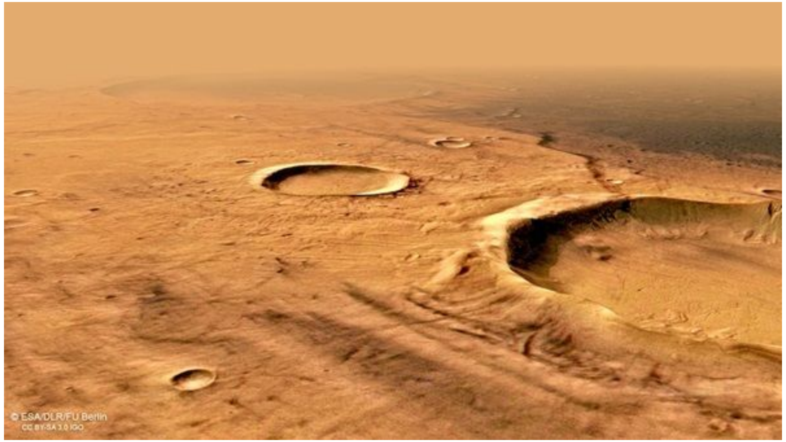
The objective for this task is to capture this process in slow motion."

Background Research

After researching, we have determined that an impacting object will hit with a significant amount of force. This force will cause the ground around it to push down and recoil. While the initial impact object may evaporate, the recoil can cause the material to rise upward into a formation such as a mountain.



The result of an impact is the crater. The crater is significant because it can reveal geologic information about the site. The breaking of the crust reveals the layers underneath and makes it very easy to see what the planet was like many many years ago. Now that we have the information we need, we can form a hypothesis on the objects we are going to drop.



Hypothesis

When these impact experiments are done, these are our expected results:

Sand and Rock:
Because the rock is significantly denser and heavier than the sand. Our rock is metamorphic which means it is fused tightly together. The amount of mass that is hitting the sand should cause a smaller rebound then the water.

Sand and Water:
We believe that when the water will hit the sand it will have a significant rebound. Water tension should create this effect. The sand should be light enough to let this happen. We expect the sand to be the ideal medium for this experiment because of its closeness to rock. The only problem may be that it is a sediment.

Water and Food Dye:
The density of the food dye and water is practically the same. This density will simulate the effects of a crater formation the best because water hitting the water will be equivalent to a rock hitting the rocky surface. We may have to put the drop higher up than we planned so the acceleration of the drop is fast enough to replicate that of a meteor.

Experiment Details: Sand + Rock

Materials:

1. A bin or small container. Ours was approximately 5x8x3 inches.
2. Enough sand to fill ¾ of the container
3. Cornstarch
4. A variety of pebbles and small rocks
5. A video camera capable of slow motion
6. One meter stick

Procedure:

1. Prepare experiment by filling the container with sand about ¾ of the way up.
2. Sprinkle cornstarch on the top layer of the sand to create a white surface. When the rock hits, we will be able to see if subsurface material moves to the top.
3. Set up a second person with the camera pointed at the sand's surface.
4. Drop a selected rock from half a meter high (50 centimeters) into the sand container.
5. Capture impact on camera a watch footage to analyze the creation of the crater.

Experimentation

Experiment Details: Sand + Water

Materials:

1. A bin or small container. Ours was approximately 5x8x3 inches.
2. Enough sand to fill ¾ of the container
3. A dropper
4. A cup of water
5. A video camera capable of slow motion
6. One meter stick

Procedure:

1. Prepare experiment by filling the container with sand about ¾ of the way up.
2. Set up a second person with the camera pointed at the sand's surface.
3. Use the dropper to drop one drop of water from half a meter high (50 centimeters) into the sand container.
4. Capture impact on camera a watch footage to analyze the creation of the crater.


Experimentation

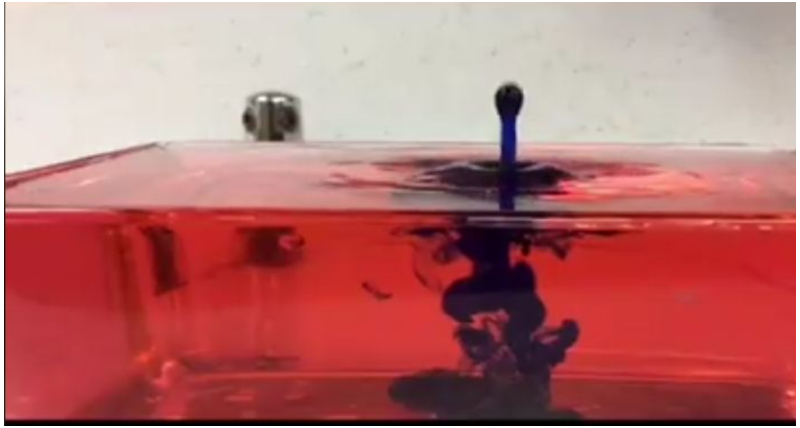
Experiment Details: Water + Food Dye

Materials:

1. A bin or small container. Ours was approximately 5x8x3 inches.
2. Enough tap water to fill ¾ of the container
3. A dropper
4. A small cup of water
5. Food dye
6. A video camera capable of slow motion
7. One meter stick

Procedure:

1. Prepare experiment by filling the container with water about ¾ of the way up.
2. Set up a second person with the camera pointed at the sand's surface.
3. Mix the food dye with the cup of water until it is the color is distinctly different from regular water.
4. Use the dropper to drop one drop of dye-water from half a meter high (50 centimeters) into the tap water container.
5. Capture impact on camera a watch footage to analyze the reaction of the surrounding water.



Experimentation

Analysis

Sand and Rock:
The rock hitting the sand had a much better bounce back then the water and sand. When the rock hit, the rock pushed downward, then moved back up, and finally settled down into the hole it created. Even though the rebound was significantly better than expected, there was no deep crater impact to show as evidence, the sand left no ridges. We find that sand is not the ideal material to use for this experiment. Not only are the particles too far apart that they absorb certain materials, but it is also crumbly enough to erase evidence of impacts.

Sand and Water:
Surprisingly, the bounce-back that we were expecting did not happen. When the water was dropped into the sand, the sand absorbed the water so quickly that it did not have enough time to push back upward. The water, however, did create an indentation similar to a crater. But it did not have a central rebound peak. There was a small, circular ridge surrounding a lower, flat area. This reaction is exactly what a small impact would make because it does not have enough mass to create the rebound.

Analysis

Water and Food Dye:
Unfortunately, with water, there is no evidence of impact after the drop. However, when we take a slow-motion camera to the drop, we can see the impact of the water dye hitting the surface. In our footage, we see the drop hit the surface and push downward. Then the surface tension breaks, and the water is pushed back upwards, sometimes becoming airborne. When the tension breaks, ripples begin to move outward just as Newton's second law states it should (equal and opposite reaction). The food dye naturally dissolves into the water. We noticed that there was a slight bit of color in the rebound peak, which means that meteorite matter could still be in many landforms. This best replicates what an impact event would look like because it shows how the materials would act in this situation.

Search for Life

Challenge Criteria

R.O.A.D.S. on Mars Challenge Official Manual Quotations

"The objective for this two-part task is to seek out these Earth analogues of "signs of past life" in the team's local environment."

"By searching for microbial life in their own community, team members will begin to gain experience in the detection of terrestrial life that cannot be easily seen by the human eye."

Background Research: Methane Detection

To begin the first part of the search for life challenge, methane detection, we gathered information on organisms that release gases and how to successfully detect them. In the decomposition process, organisms predominantly release methane gas as well as carbon dioxide. They also release nutrients into the ecosystem to become recycled as simple organic material. After research, we also found that it takes approximately 9 years for gases like methane to leave the atmosphere. This number may vary due to atmospheric differences. However, this indicates that in order to find these gases they must still be with their source. The way to find the source would be fossil records or gases trapped in the soil of the surface. It is unlikely to find them floating in the air so the best place to find this requires a little digging.

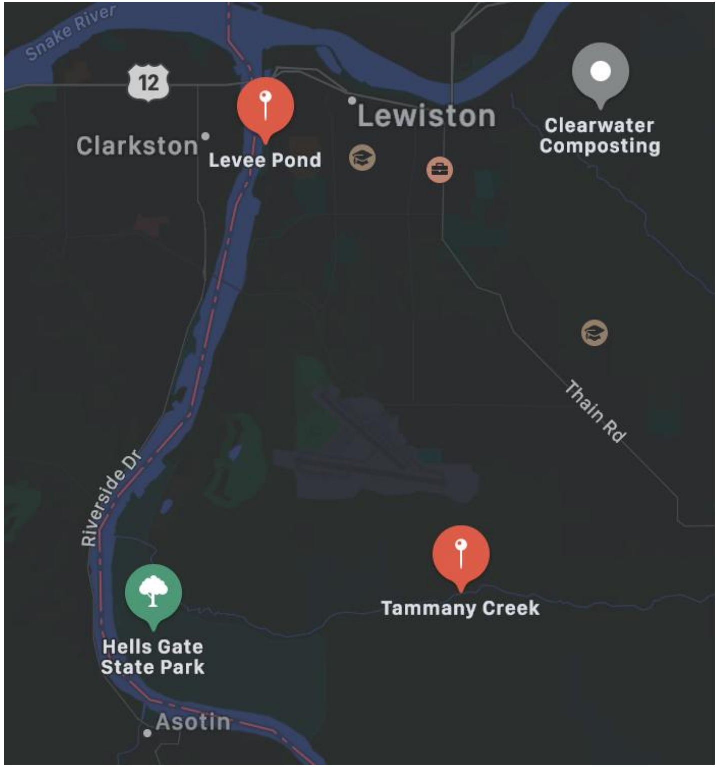
Background Research: Methane Detection PT.2

Throughout our research, we also discovered flaws in the process of methane detection. Meeting with Zac Bishop and Philip Hagihara of the Department of Environmental Quality in Lewiston, we gained some answers for our questions about combustible gases in the air. We also learned exactly how accurate the state can track air quality, and how flawed our detection could be. Finding combustible gases is an indication that life could have been there (the elements in combustible gases are essential to life), but it is not a clear indication that life was there. What it indicates is that there are elements in the area that have bonded together into a complex molecule. The most likely elements are Hydrogen and Carbon. We can say for a fact that there are Hydrogen and Carbon in the air, however, this is not enough evidence to indicate an organism created it. Furthermore, according to the Air Quality Program Manager, Philip Hagihara, there were multiple factors that can create false positives in our detection of methane. These included moisture, extreme temperature, and water vapor. Self-calibration of our methane detector also did not guarantee an accurate reading when compared to a universal scale. Lastly, changing locations meant recalibrating the equipment and possibly changing the scale.

Hypothesis

We believe that finding methane and other combustible gases will not be difficult because of the amount of decomposing things in our environment.

This is a map of the locations we hypothesize to have high amounts of methane:



- **Hells Gate State Park Result Prediction:** We thought the park would be a great place to find combustible gases. For the day we plan it should be about fifty degrees with strong winds. We do not predict this to cause any change in our results.
- **Tammany Creek Result Prediction:** We visited Tammany Creek on our first trip to study delta dynamics. We expect great results from the mud under the creek.
- **The Levee:** Unfortunately, at the time we are going to be at the river there will be snow on the ground. However, if the gases stay in the air as we predict, it should not influence the results of the combustible reader.
- **Compost Yard:** Surrounded by composting materials, it is easy to see why we predict to find plenty of vertebrates. This part of the experiment should give us an idea of what type of gases are released during decomposition.

Experiment Details

Materials:

1. Combustible gas/methane Detector
2. Soil sample auger

Procedure:

1. First turn the detector on. You should hear a clicking sound.
2. Because humans generate methane from bacteria in their stomachs, you can calibrate the sensitivity of the detector by breathing into the probe knob while slowly turning up the sensitivity. When the detector gives an audible tone. It is calibrated.
3. To detect combustible gases, point the probe close towards the decomposing material.
4. Additionally, you can use a digger to get samples of mud from underwater.

Experiment Description

- First we headed to Hells Gate State Park. We went to the creek that we used for our Delta dynamics and dug up mud from the creek bed to test for methane. We did not get any result. However, we located a leaf pile at the park and decided to test it by digging a hole in the leaf pile to place the detector in. We were able to receive a high methane rating.
- Then we went to the Levee Pond to attempt to detect methane underwater. Using a digger, we were able to extract a mud sample the bottom of the pond. This gave off a high reading of methane.
- Next we visited Tammany Creek. Though we did not detect anything when testing the rocky areas, we received high results with the creek's plant life and mud.
- Lastly, we went to the compost yard and received high results from the mud and snow on the ground as well as the manure and compost piles.

Experiment Description Pt.2

Hells Gate State Park Result:

We did not plan on testing the leaves or the river rocks, however, the leaves had a high gas combustion rating. In order to do this we had to dig a hole in the side of the leaf pile and insert the detector in. We made sure that the leaves were not wet or cold to give us the most accurate reading. The rocks on the river did not give us a good result. This could be due to the cold water and lack of plant life around this part of the beach.

Tammany Creek Result:

We pulled mud up from the bottom of the creek, the detector did not show high results for the rocky part. We got great results when he held the detector next to the extractor when it pulled mud from the bottom. The turning of the rocks released gases that were trapped beneath them. False positives are possible here due to the amount of water and the potential of water vapor.

The Levee:

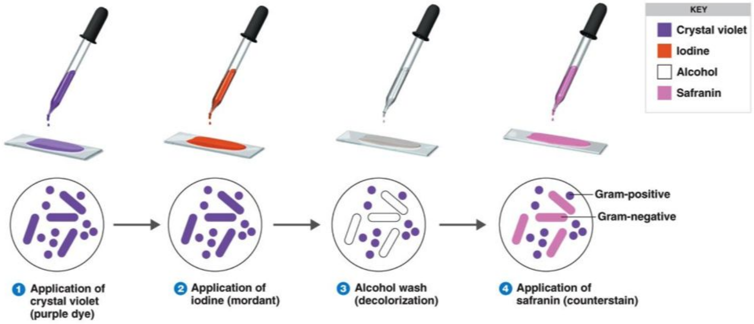
Because of the amount of wildlife in the area, (ducks!), there was a high concentration of feces in the water. This allowed for a vast amount of bacteria and decomposition to occur. A high reading could be caused by the amount of water, however due to this biological factor, it is unlikely.

Compost Yard:

It was no surprise that there was a high result at the compost yard. With piles of decaying material, the gas detector had a hard time finding a base level. The highest detection was at the manure, this is an obvious result because of the amount of decomposing material that originates from living organisms. We also got a hit off of the fresh snow on the ground. This is most likely a false positive created by water vapor.

Background Research: Search for Small Invertebrates

Beginning the second phase of the Search for Life Challenge, we first researched about microorganisms and where best to find them. We found that microorganisms exist as unicellular, multicellular, or cell clusters throughout nature. They come in varying forms such as bacteria, protozoa, fungi, algae, viruses, and archaea. Some benefits of microorganisms include producing oxygen, decomposing organic material, and providing needed nutrients for plants. They are present everywhere in nature including in soil, water, air, and the human body. In order to identify microorganisms, you must first obtain a sample from a chosen environment. Because most microorganisms cannot be seen with the naked eye, a microscope will be required to make them visible. One procedure to identify a certain organism is gram staining. This works by adding crystal violet and iodine to a sample slide and testing to see if it's gram positive (purple) or gram negative (red). Another procedure is creating observations of the microorganism under a microscope and using its shape, appearance, movements, or lack thereof to identify its type.

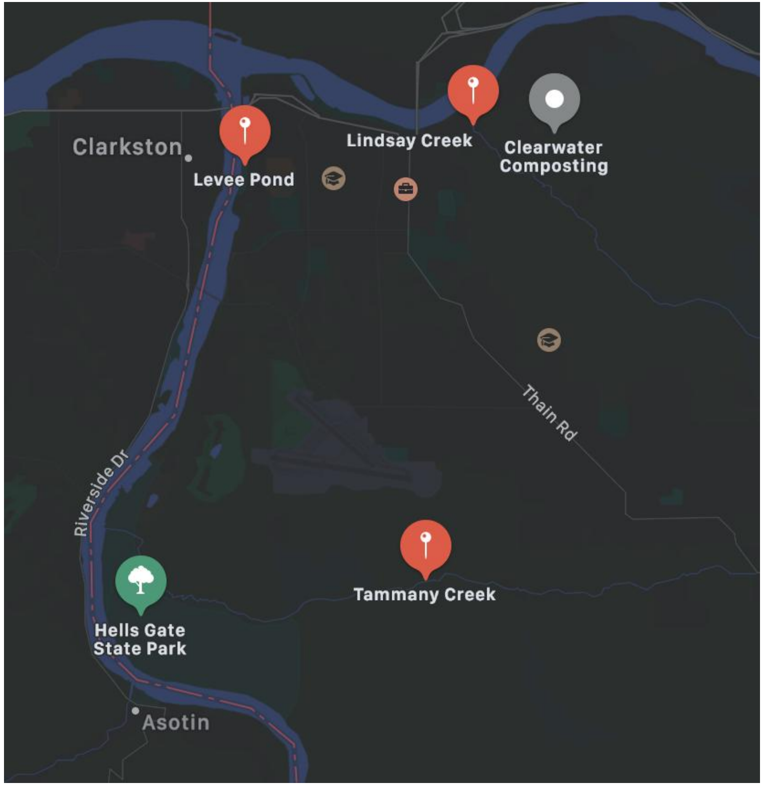


Gram staining

Hypothesis

Because we are testing in January during the winter season, we believe that the cold weather will make it difficult to locate invertebrates.

For this challenge, we are using the same locations we visited for the methane detection with an addition of Lindsey Creek:



Hells Gate State Park Result Prediction:
We thought the park would be a great place to find plenty of plant life for bugs to flourish on.

Tammany Creek Result Prediction:
We predicted that there should be macroinvertebrates in the mud just a few inches below the surface of the creek .

Lindsey Creek Result Prediction: Since we are going with a water manager from the Idaho State Department, we have high hopes for this site. This time around, we will have more equipment and knowledge about the experimentation we are doing.

The Levee: Unfortunately, at the time we are going to be at the river there will be snow on the ground. This factor could create difficult conditions to find vertebrates (even if finding them in January isn't hard enough).

Compost Yard: Surrounded by feces, it is easy to see why we predict to find plenty of vertebrates.

Experiment Description

To find small invertebrates, we first went to Hells Gate Park. We searched river rocks and trees but could not find signs of life until we searched leaves by the creek and found small, worm-like bugs. Then we stopped at Lindsey Creek where Sujata Connell from the Water Quality Department helped us catch small invertebrates with specialized equipment. Using a net contraption to catch passing bugs from the creek, we were able to find multiple types of life including an aquatic worm, a mayfly, and a caddisfly. Afterwards, we visited the Levee pond but were unsuccessful in locating much signs of microscopic life

Analysis

After visiting all of these places we gathered a better understanding of lifeforms and how to find them. Our research indicates that the best evidence for lifeforms is found near a decomposing source. This can either be found near a fresh source or near an older and buried source. If we are looking for past life, the best way to find evidence is to dig a sample, then read the gas composition.

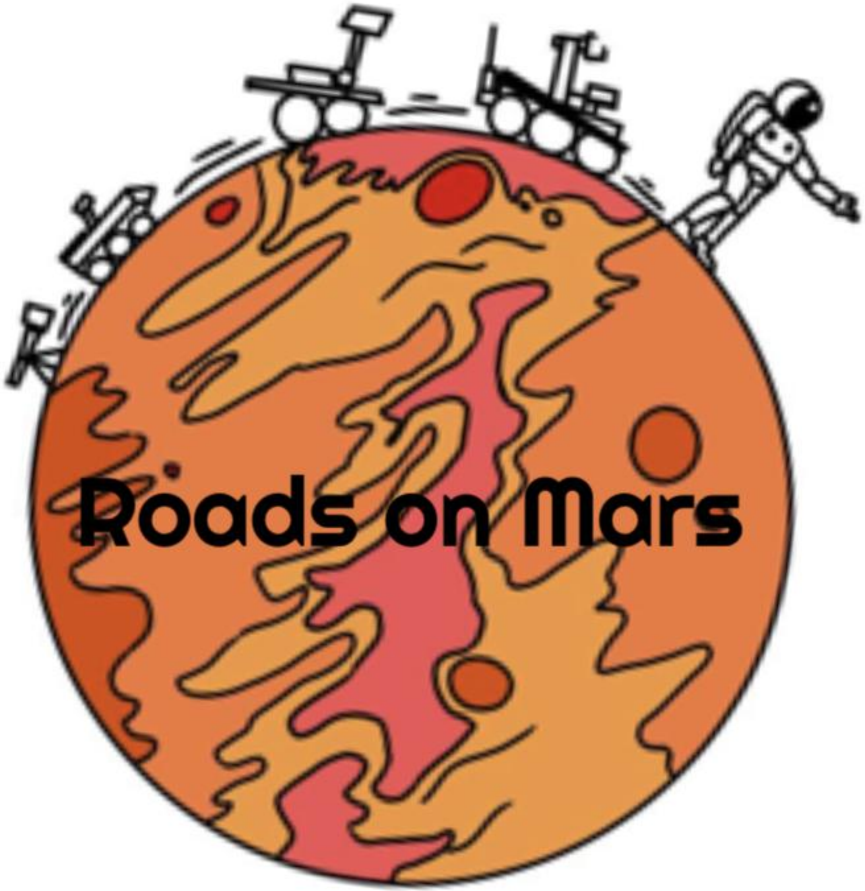
To talk more about our research methods, we found that several factors can make our readings inaccurate. For example, our gas detector can detect false positives in the right situations. False positives can come from moisture or extreme temperatures, self-calibration will not give us an accurate reading compared to a universal scale, changing location means recalibrating equipment that can change the scale, water vapor or changing temperatures also causes inaccuracy. We found that even if gas is detected, it does not mean that life existed at the spot. There are many other reasons why gas readings could show positive.

On Mars there are pyrite formations, water-rock reactions, and radiolysis of water, all produce hydrogen which can then be used to create methane with the already present carbon in the atmosphere. Methane in the atmosphere rapidly breaks down, likely due to ultraviolet radiation. Olivine can also produce methane when exposed to heat and pressure. Which could be found in the crust. Volcanism is unlikely. Methane can also be formed through discharges of water/ice in dust storms.

Mission Patch

Meaning Behind the Mission

We drew our inspiration from the evolution of machine to man. First a rover, then mankind. We felt that showing the past and the future missions of Mars was essential to making the patch.



The New von Brauns

Freestyle Challenge

This is an example of the New von Brauns working toward the mission even when it seemed out of reach. The Freestyle challenge was not a part of the original MDL but we would still like to represent our work during the struggles of today. These are a few screen captures of our experience.

Final Mission: Exploring Mars

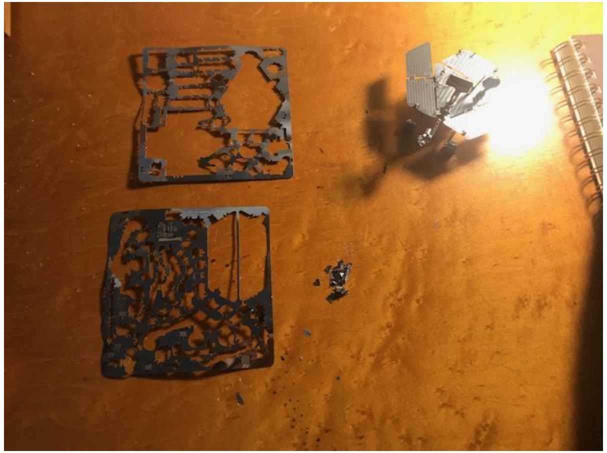
Modifications to the Challenge

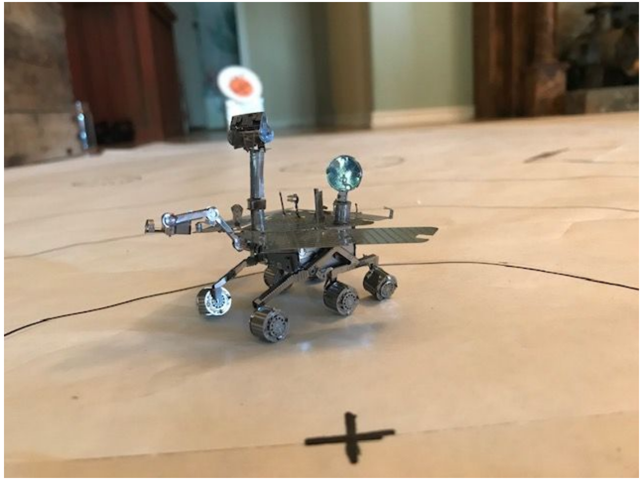
To best suit our resources, the following parts of the final challenge were changed:

- The orbit around a Mars globe was changed to an orbit around a disc brake assembly (automotive technology equipment was used because we were given permission to fly in the shop). The height of the assembly was about 3½ feet due to only having a small ladder available.
- The minidone was not launched from the robot as stated in the MDL. We had to launch the drone from the launch pad at our table.
- Each part of the mission had to be done separately due to time and the equipment we had.
- The lander was made from a kit but was still customizable and very difficult to build. The lander had to be changed to be able to absorb the shock of the fall without falling apart.

MO-01: Landing System

Our lander is a miniature model of the Opportunity rover. This model came in a puzzle kit purchased off Amazon. The kit came in two flat steel sheets that needed to be bent and put together in the exact way described in the instructions. The Opportunity rover was an amazing rover sent to Mars for an expected 3 months. Opportunity lasted 15 years despite the odds. With the information gained from its commission, the rover proved determination beyond what was anticipated. That is why we choose to build this lander, for its perseverance to complete the mission.





MO-02: Communication Dish

The objective is to build a minimum ten piece communication dish that does not exceed one foot wide and one foot tall. There should also be a personal touch to the disk to make it unique to the team.

We are proud to say that our dish assembly can move much like one would on Mars. Not only does it have wheels, but it also has the pivoter to allow the dish to twist and move to any angle. It replicates exactly what we would want a communication dish to do on the surface of Mars.

Communication Dish: Materials

Materials

- Stuffing box cut in half
- Pringles can cut in half
- Paint brush
- Lego parts (platform, wheels, and pivoter)
- Tape
- Foil
- Pringle’s can lid with a hole in the top

Communication Dish: Assembly Instructions

Step 1: Place ½ Pringle's can into the ½ stuffing box

Step 2: Put sponge paint brush into the Pringles can; cut it so ¾ of an inch of the stick is out the top of the can.

Step 3: Put Pringle's can lid on the can; there should be a hole in the center of the lid so the paintbrush is sticking out the top.

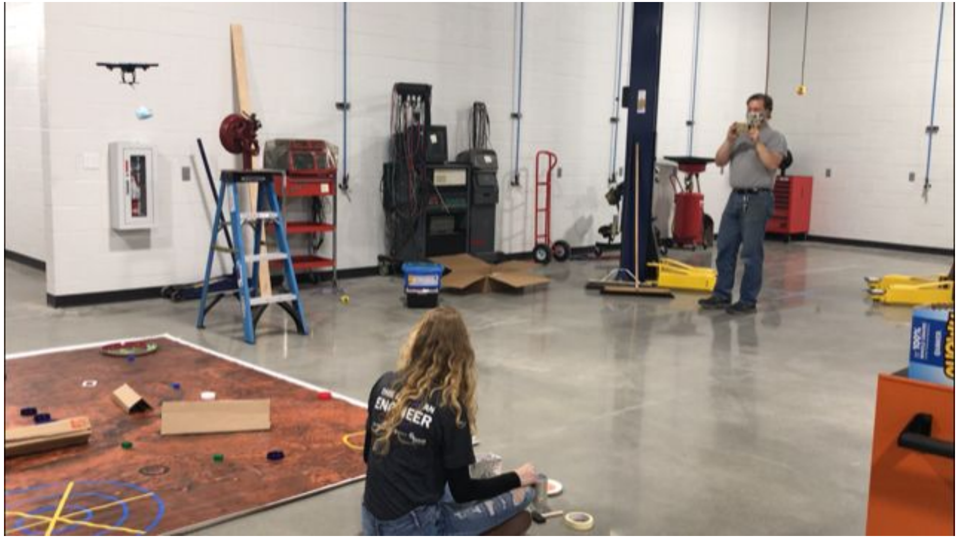
Step 4: Tape the LEGO pivoter on the top of the lid. The paintbrush stick should hold the center of the pivoter in place.

Step 5: Tape a LEGO piece to the back of the dish (lid with the logo on it). Then attract the LEGO piece yo the pivoter creating a dynamically moving disk.

Step 6: Assemble wheels on a LEGO platform then place the dish assembly on top.

MO-03: Flying to Mars

In the original challenge, a globe of Mars was put on a 3-foot pedestal and the blue heron drone orbits the planet at least once. Because of our limited resources, the drone flew around a disc assembly about 3½ feet high. To do this orbit we also had to measure the boundaries of the challenge mat and make sure to mark the area. Because the ladder was wider than a pedestal, the orbit was much more difficult to stay in bounds. However, with the expertise of Noah Williams, our drone pilot, the orbit was carried out with the lander still attached.



MO-04: Assemble Communication Dish

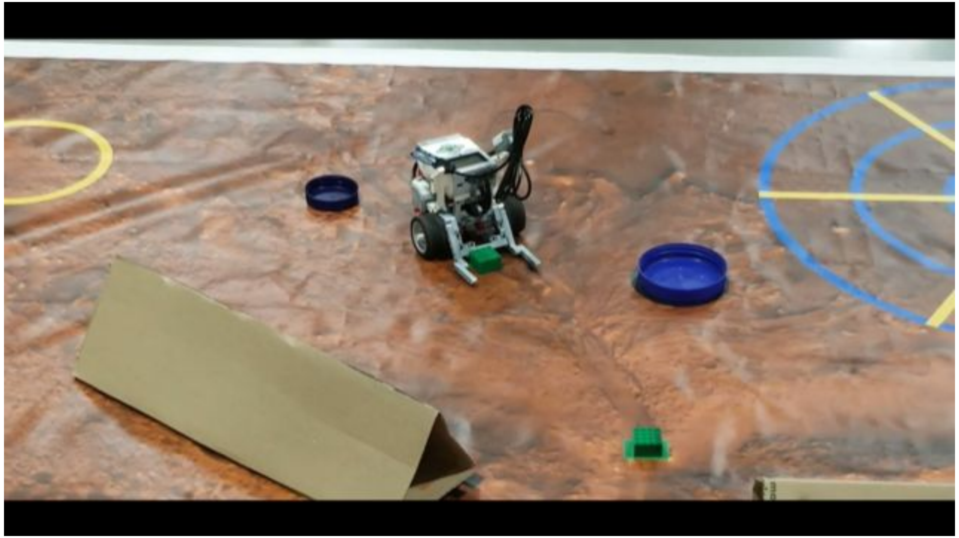
The Communication Dish must be assembled by a team member while the drone is still orbiting the planet. Only when the communication dish is complete in its place on the mat can the drone deliver the lander. With all pieces of the communication disk separated (10 pieces), Jamie Teed, team leader, assembled the dish with tape as an extra median. The drone was now clear to land.

MO-05: Entry, Decent, and Landing

The lander must be placed by the drone as close to the center circle as possible. This task is challenging because the drone uses a downward thrust to keep itself in the air. It also does not have a high weight capacity. While the lander is the proper weight to carry without causing heavy lean on the drone, the lander and landing system is light enough to be moved the drone fans. This movement causes the lander assembly to move dramatically around, making a landing extremely difficult. The best landing we could get was within the second inner circle of the target.

MO-07: Sample Collection and Caching

This part of the final challenge is to collect as many samples as possible without hitting any craters. The collection must be done by a LEGO Mindstorm robot that will deliver the sample to the cache, thus collecting points. We had many difficulties doing this part of the challenge due to problems in the programming of the robot and the complexity of the mat.



Rover Design and Testing

- Only 2 motors so lack of ability to pick up the samples, only option is to drag/push samples
- Since we could not pick up the samples the rover design changed multiple times to get a more consistent run, as the friction from the samples would cause the sample to occasionally catch on the mat, and change the direction of the rover.

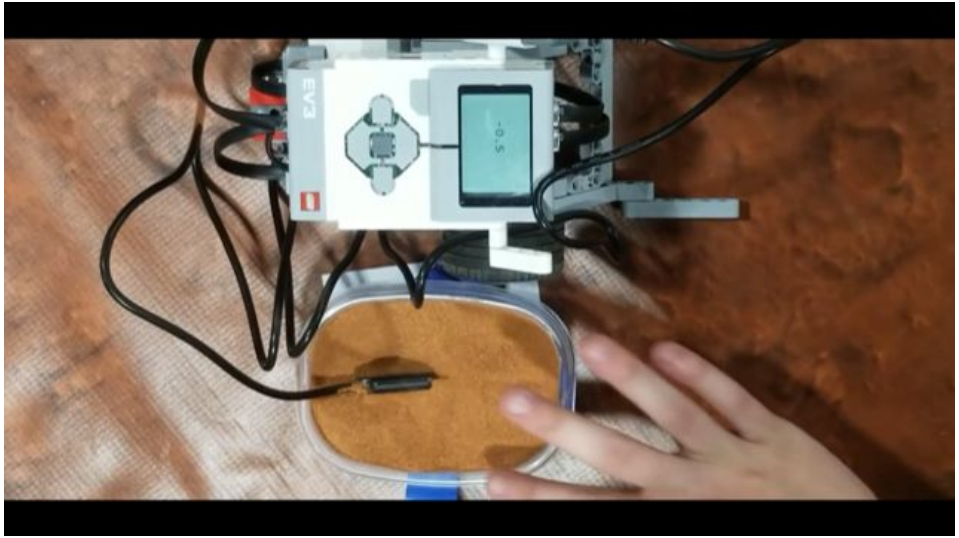
- Testing the rover was very difficult as any minor change to the mat could create drastic differences in the testing. Even if the rover was in seemingly the same exact spot it sometimes ended up far away from the intended target.
- As any small change could majorly change the course of the rover, and every run was seemingly different, developing a working code for the rover was painstakingly difficult, and our current code should work in theory, as every individual part works, but the rover could end up going entirely different direction after the first few turns.

Rover Next Steps and Suggestions for Future Competitions

- An inclusion of one or two additional motors would allow for finer precision with the ability to pick up and transport samples, without damaging the samples or adding additional unforeseen variable that could affect the trajectory of the rover.
- Using a more uniform starting position would have immensely helped, even slight variations in the starting position made later portions of the run strikingly different.
- Having a flatter floor, or less wrinkles in the mat could have helped remove variation.
- Since the rover can be started multiple time, and has bluetooth, using multiple sections of program rather than one long string would likely of helped.

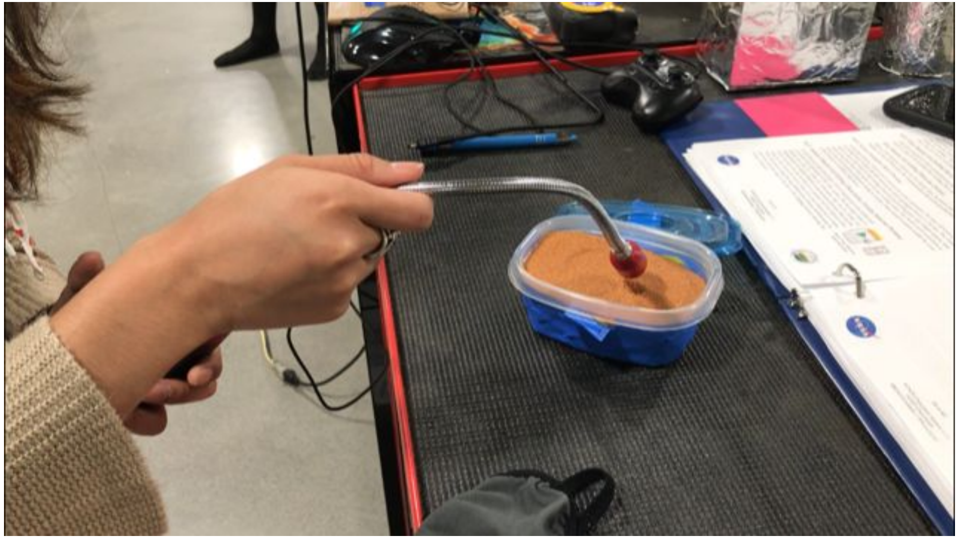
MO-08: Probing the Surface

Once the samples are collected, the LEGO Mindstorm robot now has to probe the surface and detect if there is any water. Aiden did an excellent job working with the sensor and getting an accurate reading. Our sample had very little water detectable. This result was not surprising considering how sandy the sample was.



MO-09: Methane Detection

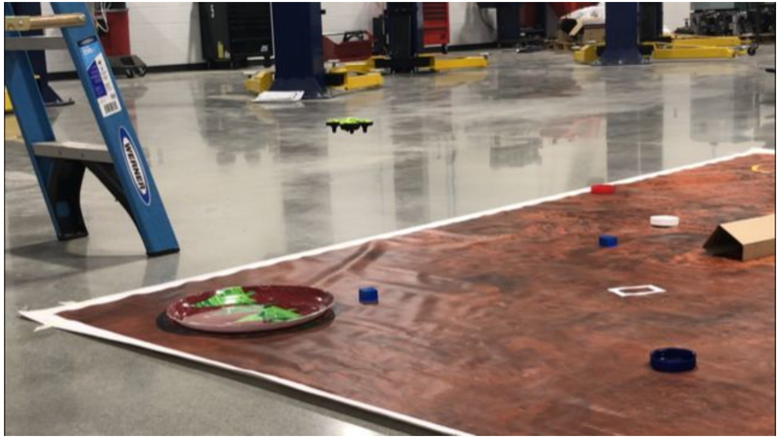
Using the same sample for the probing, we will now work into the methane detection. Janina Daep calibrated and used the methane detector over the sample. She concluded that there is no methane in the container. From this analysis we know that it unlikely that there was any living material interacting with that soil.



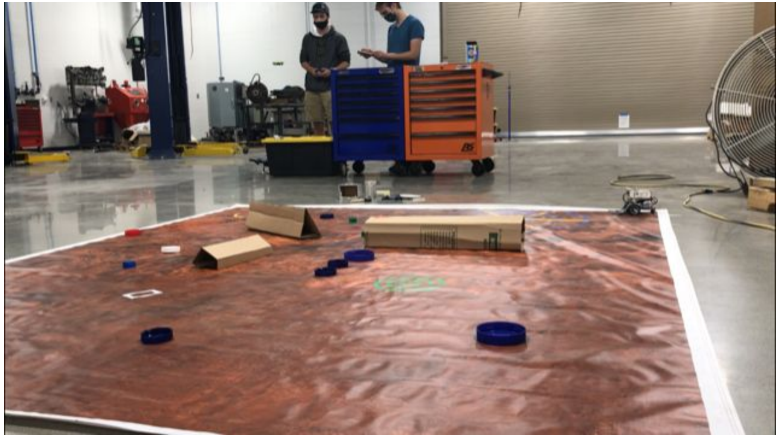
MO-10: Macro-Invertebrates

When we finally reached the second sample site, Janina Daep again proved her skill by determining what samples were organic or inorganic. Janina did a great job of putting together the microscope, focusing on the slides, and determining if they were alive at some point. She concluded the first sample had a crystalized structure meaning it was inorganic. The second sample had green cells indicating it is organic.

MO-11: Crater Exploration



For the last part of the challenge, Noah Williams flew the mini-drone over the 3D crater. His mission is to take an image of the inside. The mini-drone was an excellent tool because of the camera that could be linked to a phone. We did not have a crater replica, we decided to use a bowl as the crater. Also, the mini-drone could not launch from the robot because we had to do each part separately. On that particular day, the robot was having technical difficulties. We opted to fly the drone from the control table and land in the same spot.



Social Media Plan

Applications

These are the apps and programs we used to submit and create our videos

- Facebook: Our Profile, Roads on Mars (The New Von Brauns) is where you can find all our video content, as well as pictures, and our Mission Patch. https://www.facebook.com/roads.onmars
- InShot: The video editing app used to create all of our videos.
- To see our video outline, scripts, and other notes, you can visit the following link to our video Google Drive folder.

Team Attire Design

Team Attire:

The team attire for the competition was going to be lab coats, mission logo t-shirts, and safety glasses. We were going to borrow white lab coats from the chemistry class to use. Another expectation we had was to wear black pants as well as t-shirts with the team logo on them. Our plan was to send our design to Artbeat, however, with the sudden cancelation of the competition and businesses shutting down, we never got the chance. The t-shirts were going to be white with the logo on the back and the “New von Brauns” in the top corner of the front.

Thank You!

Our team is so grateful to participate in this challenge. We offer a special thank to everyone involved in making ROADS on Mars happen!

Extra Resources

Our Videos

Watch our mission progress with our video submissions!

Delta Dynamics

Crater Formation

Search for Life

Freestyle

Final Mission