**Katie**
**Emerson**
**Hanna**
**Andrew**
**Isabella**
**Completed** **Getting close** **Missed** **Incomplete**

**Official Arizona ROADS Timeline-**
SEPT 23,2019 Official Launch of ROADs on Mars,registration opens
NOV-JAN 2019-2020 Professional Development
JAN 13,2020 School Year Registration Closes
JAN 15,2020 Virtual Meeting with ROADs team for support and questions
**FEB 3,2020 Erosion MIni-Challenge submissions due**
FEB 5,2020 Virtual Meeting with Mars scientist
**FEB 24,2020 Search for Life Mini Challenge Submissions due**
**MAR 16,2020 Mission patch submissions due**
MAR 31,2020 Nominate teams for regional challenge event
APR 6,2020 Invitations to Regional Challenges Announced
**MAY 1-2,2020 Regional Challenge at NAU**
JUL 17-AUG 5,2020 Grand Prize Visit

**COVID-19 Updated Timeline-**
SEPT 23,2019 Official Launch of ROADs on Mars,registration opens
NOV-JAN 2019-2020 Professional Development
JAN 13,2020 School Year Registration Closes
JAN 15,2020 Virtual Meeting with ROADs team for support and questions
**FEB 3,2020 Erosion MIni-Challenge submissions due**
FEB 5,2020 Virtual Meeting with Mars scientist
**FEB 24,2020 Search for Life Mini Challenge Submissions due**
**MAR 16,2020 Mission patch submissions due**
MAR 28,2020 ROADs Freestyle Challenge Launch
MAY 18, 2020 ROADs Freestyle Challenge due
JUN 16, 2020 ROADs Reboot Announced
SEP 28,2020 MDL DUE
SEP 28,2020 uncut/unedited video due
*MUST BE POSTED ON SOCIAL MEDIA*
OCT 5,2020-Winners Announced

**OUTLINE**

**MDL RUBRIC-**

- Social Media Plan
- Delta Dynamics
- Crater Formation
- Mission Patch Design
- Methane Detection
- Search for Small Invertebrates
- Rover Design & Testing
- Team Attire Design
- MO1 Landing System Design
- MO2 Communications Dish Design

**VIDEO LOG OBJECTIVES(Curiosity Division)-**

- MO1: Andrew
    - Landing system flown by Force 1 Blue Heron
    - Modeled after Mars Rover
    - We made a prototype first to practice flying with a lander beneath the drone.
        - Prototype was basically a box.
    - Practiced for about 2-3 hours orbiting and landing with the prototype before it broke.
    - We made our final lander and named it steve.
    - Practiced for an additional hour with Steve, trying not to drag.
    - Difficulties
    - Steve was blown by the wind of the drone, making it very difficult to land in the right spot
    - It was difficult to make a landing system that didn't let go while flying but let go when landing.
    - The hardest difficulty however was landing steve without dragging, because the way we built steve made it like to drag. A lot.
- MO2: Emerson
    - Design, build, and assemble a communication dish
        - Have at least ten components (tape, adhesives, string do not count toward your ten components)
        - • Have at least one round component that fits within a square component (in recognition of the problem faced during the Apollo 13 mission
        - Be free standing when built
        - Be no larger than a 12-inch diameter or maximum length
        - Be designed to represent the team’s community
        - I started making the dome itself as that was the easiest to make in my previous design, so I used 2 layers of cardstock to make a sturdy dome for the dish, then took some skewers and cut them to

length to make the transmitter/receiver part of the dish. For the square into the round component I used a long wooden stick that poked into the back of the dish where a foam bowl was to stabilize the cardstock. I used a plastic cup to make the tower part of the dish. And for the base of the dish I used a flat piece of wood with a hole in it for the stick to hold the dish together, and for the stands I friction fit some small pieces of wood.

- MO3: Andrew
    - Fly the UAV and model landing system to Mars and complete at least one orbit around the planet.
    - Mars will be on a 3-foot tall post and to the side of the challenge mat. Mars will be 16 inches in diameter.
    - Practiced orbiting at home for like 2 hours. Failed miserably.
    - We then built mars, we had inflatable planets, so we thought it would be fun to use an inflatable mars as mars.
    - However, we found that the inflatable mars was too small, so we used Jupiter, which was the right size.
    - After some trial and error, we found that using string, and then securing the bottom with weights worked well.
    - Except when the drone got caught in the string.
    - Practiced orbiting for about 1.5 more hours, still failing miserably.
    - Decided to use a different type of orbiting.
    - Instead of trying to move in a constant direction while changing the orientation, which done right would lead to a perfect ellipse around mars, we decided to keep the orientation constant while moving going in a circle-ish motion around mars. Worked well enough, and much easier to keep control.
    - The biggest difficulty was trying to do a perfect orbit, but after multiple hours of unsuccessful attempts, we decided to do an easier orbit that doesn’t look quite as good.
- MO4: Emerson
    - Upon arrival of the drone at Mars, the team will assemble the satellite dish, which must be self-supporting
    - Must assemble the dish in real time during the Challenge.
    - Your UAV must remain in orbit around Mars while the team is assembling the dish.
    - We had to do a few tries to get the time to build the dish down to ~ 20 seconds to make it easier on Andrew to not have to orbit for so long. We took 2 takes for the flying and dish building, but we ended up getting a perfect landing for the rover and the dish was done fairly quickly so we used the 2nd take.
- MO5

    - Only after completion of the communications dish will the team be allowed to attempt to place the lander on the surface of Mars in the specified blue Landing Zone circles using their Landing system

- MO6
    - Only spirit
- MO7: Hanna/Katie
    - LEGO Mindstorms robot will be used as a rover to perform the exploration of the Mars surface.
    - To simulate limited communications between Mars and the Earth, the team will only be allowed to transmit and run adjusted codes using the play buttons in the software up to 6 times
    - The rover will be started at the center of the blue landing zone circles and can be pointed in any direction that the team desires.
    - It will need to traverse the mat collecting as many LEGO Samples (located on the green and blue rectangles) as possible and drop them off at the caching site (green circles).
    - For a rover to collect a LEGO Sample, the rover must have full control of the LEGO Sample either by picking up, pushing, pulling, or dragging. *Judges will determine if a rover is in full control of LEGO Sample.*
    - Both LEGO sample types, blue and green, can be collected for points The two blue LEGO Samples are worth more points than the three green LEGO samples.

    **Rover Setup:**

    - Building this robot was no easy task due to the multiple tasks we had to complete this year. In the very beginning we had the normal setup with 4 tires and a square chassis. Once we figured out all the tasks we had to do, that is where our creative minds took off. We built two arms to extend out of the robot to collect the samples and keep them safe while the robot was in transit. We realized pieces started going under the robot so we put two poles in the inside of the arms and put small lego pieces spread evenly apart to prevent the samples from going underneath the robot. After we got that complete we had to find a way to get a gyro sensor and a soil moisture sensor on our robot. We were able to get the gyro sensor on the side of the robot to keep it straight during our sudden movements. We were able to put the Probe (soil moisture sensor) on the back of our robot connected to its sensor that lays on the very top of our robot. With all of these wires coming in and out from different connections that were necessary to get our robot to function zipties became very useful in keeping those wires away from getting caught on anything that could tear them. Once everything was ziptied we were able to accomplish so much more with a completed robot.

### Mars Rover Route:

- For a second year in a row I was in charge of coding Mr.Bartholomew to navigate the map of Mars. This year has been one of the best challenges yet, due to Covid-19 and the rules changing. We did not let that get to us, the Ares Bobcats found a way to social distance while getting this challenge completed. When I first started coding there were problems with the length in inches vs the degrees in turns. To overcome this barrier we pulled out a yard stick and measured every possible inch to get from point A to point B. From there I was able to get an idea of the distance from each sample to the next one. We started getting really good runs and then I was like how can we make ourselves stand out from others, this is where things got interesting. We changed the route our Bartholomew would take to grab all of the samples and return them back to home base. We came upon the struggle of having too many samples in our carrier where it would make it impossible to get them all in the center. The solution for this was to change the route to make it have two stops at the green center instead of just one. With that being said we were able to collect the first 4 samples and return it to the green target, from there we coded a back up motion and turn to make the probe run straight into the dirt so Isabella could identify whether or not life was sustainable. From there we were able to drive forward and turn to go get the last sample in the beginning of the map. Once we grabbed the sample we were able to go around the map to head right back to the green target now the plus of this was we could push the other samples more towards the middle if they were not already there. This concluded the mapping of our robot for the Mars mission.

### Rover Route Obstacle:

- When coding a robot there is not one single task at hand that is easy, when you think something is going right well you thought wrong. I wanted to highlight the issues we had during our experience of coding because that is very important, we do not want to leave out any details. We as a team came across the problem of setting up the robot, with the 3D map it brought a great struggle measuring the perfect distance from point A to point B because if you accidentally mis-position the robot it will throw off the entire route which really sucked. This year you had to start in the middle of a target but not one human is perfect and we all make mistakes and that is what kept happening with the robot. Setting it up in one single position every single run through was rough. When we would get a perfect run off camera and try it for a second time the robot would take a completely different path that would really bring our spirits down. Another problem we ran into was adding weight to the robot, you could add a small lego and it could mess up the way the robot received information which was really weird, to overcome this barrier we made a day that was specific to finishing all touches to the robot which helped keep the balance of the robot. During this pandemic we were very limited on this mission, an issue we had was out map would NOT stay flat no matter what we tried, it would always bubble in certain areas and throw off the robots route, not only that but the tile in the classroom had dents and marks on it that made things challenging because the rover was so easy to accidentally make a mistake. Of course being the Ares Bobcats we did not let all of this get us down, we turned up our playlist and put our focus on the prize. Day in and day out we made sure we got something together while we had the chance to meet in person following the Covid-19 guidelines.

- MO8-Isabella/Hanna
    - Teams in the Curiosity Division will also have the rover navigate to the white rectangle.
    - However, they will use a Vernier Soil Moisture Sensor to determine whether the soil has a significant water content or not.
    - A video on how to use the probe is available at the Challenge website.
    - When using the Vernier Soil Moisture Sensor, we were struggling with adding the sensor to the rover. We ended up adding it to the back of the rover and programmed the rover to drive backwards to analyze the moisture percentage of the dirt. Afterwards we watched a video on implementing the sensor in the code … We had a fun time with this project
    - The Vernier Soil Moisture Sensor was not through the mindstorm programming service it was through the NXT programming service, now this was a very interesting task at hand because coding a sensor not a part of your program can become very difficult very fast. We finally figured it out!!! For an NXT sensor to work on a mindstorm program I had to calibrate the sensor and turn it into its own separate code to attach to our other code. When you make a new code it deletes everything you had previously on your program. This was devastating due to the short amount of time we had to finish the program but we worked fast as a team and connected all the pieces together and ended it successfully.
- MO9-Isabella
    - After the rover has collected its first LEGO Sample, a team member will be given a combustible gas detector and mystery sample by the officiating

judges and the team will determine whether the sample is a source of combustible gas or not using the combustible gas detector.
    - When using the Combustible Gas Sensor, I calibrated the sensor by blowing into the sensor, listening to the ticking, and changing the sensitivity. Afterwards I analyzed the gases coming out of the dirt from decomposing leaves to bugs. This helped me determine if the soil was sustainable or not based off of the bacteria decomposing organisms in the dirt.
    -
- MO10- Isabella
    - After the rover has collected a second LEGO sample, the team will be given a microscope slide(s) and allowed access to a digital microscope to determine if the sample(s) are organic or inorganic in origin.
    - Sample slides will be posted on the Challenge website in early 2020.
    - When using the Microscope Slides, I started setting up the Microscope and analyzed several dirt that my team assigned me to analyze. I found out that Samples Rooms 200, 300, 500, 600, and 700 did not have any living organisms since the soil was not sustainable for life. However I noticed that Rooms 100, 400, and Cow Dung had microscopic bugs crawling around the dirt. This makes the dirt sustainable.
- MO11-Andrew
    - Fly a mini-drone carried by the LEGO Mindstorms robot into the center of the large 3D crater.
    - Use the mini-drone camera to take a photo of the inside wall of the crater and return it to the LEGO robot.
    - The mini drone is not required to enter the crater.
    - It is okay to hover above to obtain the photo.
    - We found that the mini-drone was much easier to fly than the blue heron.
    - Ease of use and limited battery time means that I only practiced for about 1-2 hours total.
    - Taking the picture was slightly more difficult, simply because it was hard to find a place to hover where the camera would actually take a picture inside the crater.
    - The hardest part was honestly just building a platform on the rover that had enough room to land on, and would lift off without getting stuck.
    - Another challenge was that the mini-drone suddenly became suddenly unpredictable, and made it really hard to land.
        - Turns out there was a hair stuck in one of the motors, making upward thrust uneven.

**Social Media Plan-**

- Opened up new social media account on Instagram
    - @ares_bobcats https://www.instagram.com/ares_bobcats/

- Try to post at every meeting
- Post all mini challenges
- Follow as many teams as we can find
- Follow NASA and NWESSP to help stay updated
    - And NAU(Regional Hub)

**Delta Dynamics(Mini Challenge 1)-**
**https://www.instagram.com/p/B6T4aUoA80f/?utm_source=ig_web_copy_link**

- Need to post video of tables on social media using the required hashtags before deadline and submit it to the official NWESSP website.
- Materials-
    - Diatomaceous earth
    - Water
    - Tables
    - 5 Gallon bucket
    - Pipette
- Key Questions
    - Can water flow explain the alluvial fan in the Jezero crater? yes
    - If so was it produced by a fast flow (like a flash flood) or a slow continuous flow? Slow continuous.
    - If team members added trees, houses, or other features to their terrain, how did those items affect the water flow? Did not do
    - How did the water flow affect those items?
    - Are there places in your community or state where similar processes are occurring?
    - What steps, if any, are being taken to stop erosion? Placing plants in soil helps keep the soil together, and reduces the rate of erosion. Also, in some washes, the banks are formed out of concrete, which is very sturdy and resistant to erosion.
    - To look for evidence for past life, where would be the best places to take samples? Places where erosion is present.
    - Description
        - We wet diatomaceous earth and spread it out evenly in a long tray. We then propped it up with a couple of blocks.

**Crater**
**https://www.instagram.com/p/B6T5CNfgzR9/?utm_source=ig_web_copy_link**

- Key Questions
    - How do craters form? Extraterrestrial bodies hitting the surface.
    - Can crater formation provide insight into the processes that shaped other objects in the solar system? Yes, because we see the same types of patterns on other planetary bodies and were most likely formed by the same types of events.
- The objective for this task is to capture this process in slow motion

- Teams may attempt one of the following, but we encourage team members to be creative and select their own impacting object and surface/subsurface material!
    - A drop of food dye into water
    - A drop of water into sand
    - A rock into water or sand
- Description of drop
    - We used flour that has been sitting in the supply closet for an unknown amount of time. We then found relatively spherical rocks and dropped them into a pan of flour from a one meter and two meter height. The flour was covered with a layer of hot chocolate mix that has also probably been in the closet for way too long in order to show the ejecta contrasts.

| 2 Meter Drop | 3cm Meteorite | 4.4 cm | 7 cm |
|---|---|---|---|
| Width of Crater (cm) | 3.5 | 4.5 | 9 |
| Depth of Crater (cm) | 6 | 4.2 | 8.5 |
| Ejecta (cm) | 37 | 50 | 67 |

| 1 Meter Drop | 3 cm Meteorite | 4.4 cm | 7 cm |
|---|---|---|---|
| Width of Crater (cm) | 3 | 5 | 8.5 |
| Depth of Crater (cm) | 1.5 | 2.8 | 6 |
| Ejecta (cm) | 10 | 24 | 40 |

**https://www.instagram.com/p/B6T5CNfgzR9/?utm_source=ig_web_copy_link**

**Search for Life Mini-Challenge(Methane Detection/Small invertebrates)-**

- https://www.instagram.com/p/B8-Z2cup2I2/?utm_source=ig_web_copy_link

- Materials
    - combustible gas detector
    - Microscope
- Create map of area surveyed
- Theorize about where methane could be present in our community
- Mark areas on map of high methane detection
- Search for small Invertebrates in local area
    - Visit area of highest methane detection
    - Collect samples that may contain invertebrates

- Check for any form of movement
- Image under microscope
- Compare how microscopic life forms are so different yet humans interact with them on a daily basis.
- Most interesting places/samples The most interesting samples I've analyzed with the Combustible Gas and Moisture Sensor are Rooms 100, 400, and Cow Dung. Since these samples did have enough moisture in the dirt, this made these samples place as the most interesting samples.
- Most boring places/samples The most boring samples we've analyzed with the Combustible Gas Sensor and Moisture Sensor is dirt from Rooms 200, 300, 500, 600, and 700. Since these samples did not have enough Moisture to help sustain life, this made these samples place as the most boring samples.
- How were samples identified? The samples were identified through using the Moisture Sensor and the Combustible Gas Sensor. For the Moisture Sensor, plug the lego cable into the Mindstorms Adapter and the Mindstorms, and then plug the Vernier Sensor into the Vernier NXT adapter. This records the Moisture in the soil. For the Combustible Gas Sensor, we calibrated the sensor by blowing into the sensor, listening to the ticking, and changing the sensitivity. Then we analyzed the gases coming out of the dirt from decomposing leaves to bugs. Both of these sensors help determine if life is sustainable in the soil.

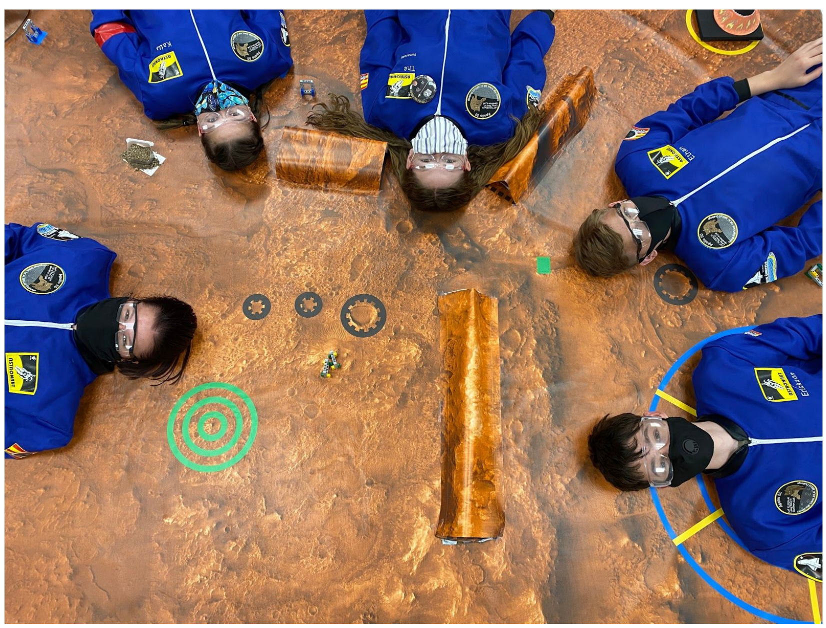
- Post video on social media using required hashtags and submit to the official NWESSP website before the deadline.
  https://www.instagram.com/p/B8-Z2cup2I2/?utm_source=ig_web_copy_link

**Mission Patch-**
**https://www.instagram.com/p/B9e3fOJJOrQ/?utm_source=ig_web_copy_link**

- A few members of our flight crew participated in the ANGLeS Challenge over the summer of 2019. The requirements of our mission patch were similar to this year's requirements. We decided to base our mission patch this year off of the mission past from last year to pay homage to the ANGLeS mission.
- Items depicted on patch and meaning
  - Bobcat
    - Our schools mascot
  - ARES Bobcats
    - Team name
    - Ares is the roman name for mars
  - Mars
    - We have the bobcat leaping over mars to represent the challenge and it taking place on a mars map and in support of the Mars 2020 rover launch
  - Vail's Coordinates/Elevation
    - Our teams hometown
  - Clubs Name

        - Astronomy/STEM
    - ROAD to Mars
        - Challenge name


**Team Attire/Design-**

- We chose to reuse the astronaut uniforms we used for ANGLeS last year simply as a way to save money. The teammates who did not return were kind enough to let us use their uniforms for a couple weeks. The mission commander uniform had red stripes made with duct tape to make it stand out. We also made sure to be wearing masks and safety goggles. 

**Prohibited Items-**

- Teams may not use any of the following methods or materials during the challenge
    - Pyrotechnics or explosives

- No adhesives in contact with the challenge mat other than to secure the mat to the floor.
- Drones may not be modified in any way that increases flight performance characteristics.
- Any form of remote control or direct operator interface for the rover.

**Questions list-**

- Do we need to return the rover back to the blue circle? NO
- Do we need to pick up a lander with a drone and fly it back? NO
- Are there any other hashtags we need to use of than #ROADSonMars and #Mars2020? NO
- How many points is the challenge and mini challenges worth for the curiosity division? 6 each
- Can we use another drone other than the blue heron? NO
- Is there a time limit on the challenge? 10 MIN