AGNESI ROVER

NCAS Online

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(For context, this proposal received a perfect score from NASA NCAS)

Ever since humanity has seen Mars, it has dreamt of living there. For centuries the idea of living on Mars was just that—an idea. But with the epic strides being made in technology today, the possibility of permanently living on Mars is becoming a reality. The NASA Agnesi Rover will help plan that reality. Agnesi objective will be to investigate an area over time to determine the area's viability for a permanent human habitat and, if that area has been deemed viable, will allow anyone—engineer, scientist, or student—to immerse themselves in Mars through legitimate virtual reality; a virtual reality that is created from actual 360° photos of Mars. The beauty of this is that people can experience Mars, as it actually is, however they'd like and do whatever they want. Students, for example, might want to try and find their house on Earth, Astronomers might marvel at how much closer Jupiter is on Mars, some random Joe in a parking lot might model a Martian McDonalds. Anything can be done because with technology like Agnesi, the possibilities are truly endless. And at the same time those separate experiences are happening, NASA will be hard at work using Agnesi's data to design a future Martian colony.

Agnesi and its instrument panel are designed to be pragmatic, efficient, and streamlined which gives it a novel design; fitting as it literally is always looking towards the future. Agnesi's scientific objectives align perfectly with its design and objective of finding and surveying an area most conducive to a future colony's success. In truth, Agnesi actually has three primary objectives—soil, wind, and chemistry—with specific objectives neatly collected in those three primary objectives. The soil primary objective encompasses the goals of density and erosion. All three goals are important for actually building on Martian soil—a feat that hasn't been accomplished before. The goal of soil density is important for many reasons[6]. Density of soil is directly responsible for how easy it is to drill through soil and access lower soil layers. Knowledge about soil density would give scientists clues to how Mars was made and through what kind of process. Soil density would additionally give clues of where water may exist closer to the Martian surface. For a future colony, this would matter because it might one day affect a colony's water system and ability to acquire underground materials like water for drinking and methane for fuel. But more importantly it would dictate if a building could be built in that area and, if a building can be made, directly limit how tall, wide, and heavy it is. Soil erosion is directly related to density of the soil because less dense soil is more likely to erode over time.[1] Soil erosion is important to NASA because it would allow them to determine how wind affects the soil and breaks down bigger rocks. This movement could give an insight into how and why Mars is littered with such diverse rock structures in size and in shape. Erosion would also directly dictate how well a building will stand because a heavy habitat on loose soil could actually experience sinking—the same phenomenon experienced by the Burj Khalifa. Next, the wind objective encompasses wind speed, pressure, and weather changes over time. NASA would be interested in Martian wind speed because of the extremely common dust storms that occur on the Martian surface. These dust storms are seen as random events but if research using Agnesi's data were conducted, patterns could be ascertained and the dust storms can be modeled and planned. Moreover, gale force winds could cause extreme issues for a habitat as dust could find its way into necessary life systems or debris could threaten to destroy a building. Areas with high propensity for wind would be considered unviable for these reasons. Lastly, the chemistry objective is necessary because it would give scientists a better idea to composition of materials on different Martian areas. For example, a drilling operation might unearth a dark black substance that scientists are unfamiliar with. Using the chemistry-specific instruments, the substance can be identified and inferred. As a consequence, this might either corroborate current ideas or might introduce a new understanding of Martian composition.

Agnesi's chassis is designed to be as tough and lightweight as possible. The main support is a central titanium beam with three perpendicular beams across the middle and ends. Titanium was the obvious choice as it has an incredible strength/weight ratio[2] and its nonreactivity in the Martian atmosphere. This beam acts as the 'common point' where most peripherals are attached. The wheel assemblies, for instance, exist at the ends of the perpendicular beams in order to better spread out weight and lower the overall center of gravity which would make Agnesi much harder to tip and therefore more terrain capable and versatile which works in addition to the angle at which the wheel assemblies are kept to give Agnesi a bigger surface area akin to the build of a spider. Agnesi's shell is molded to act somewhat like an airfoil to give wind a way around instead of against the body and prevent tipping. Keeping in line with the idea of being future-forward, Agnesi's shell is made out of polypropylene. Polypropylene is an incredible plastic that would be perfect for the Martian atmosphere due to its toughness, low reactivity, high strength/weight ratio, heat resistance, and ability to be molded.[3] This shell will protect and shield all the important internal instruments like the NavCam, computers, batteries, and MMRTG. The shell will be bonded to the titanium beam and provide an airtight seal within the rover proper.

Agnesi has two unique power sources somewhat similar to a hybrid car. Primary power is provided by NASA's tried and proven Multi-Mission Radioisotope Thermoelectric Generator. Use of the MMRTG[5] was picked because this system can provide near constant reliable power output and serve as a heater for internal components. This allows Agnesi to more ably regulate its temperature and save weight on a heater. The secondary power source comes from two whole arrays of solar panels gracing the topmost part of the polypropylene shell. Solar panels are treated as the secondary source of power because of the lower irradiance on Mars.[4] Because of this, sunlight isn't as reliable or powerful a power source but nevertheless is necessary to provide additional power for things like steep hills or laser usage—both energy intensive endeavors. During everyday operation, the solar panels will provide the bulk of power with the MMRTG making up the deficit.

The instrument panel on Agnesi is perfectly suited towards completing the outlined objectives. On Agnesi's sides are arms with a small drill and density/compression sensors. The drill will provide access to lower layers of rock and specimens investigate while also giving a preliminary idea to composition. The sensors, located on the opposite end, will be able to test density at different layers of soil. It will be able to give empirical data for the less dense top layer and, following the hole dug by the drill, measure density of that layer as well. Soil erosion in this situation would be to measure the depth of the excavated hole over time and recording how much it has backfilled. Also, the density sensors will be able to measure how hard a given rock is and give inference to its internal structure and feasibility as building material. The wind objective will be met by an anemometer and an altimeter/barometer/thermometer combination. The anemometer will record wind speed of an area over time and provide data to scientists which will allow them to plan future Mars missions and model wind patterns of an area over time. The anemometer uses ultrasonic frequencies to measure wind speed and will be utilized due to its longevity, high-efficiency, small size, and the fact that once set-up, it doesn’t need re-calibration. The altimeter/barometer/thermometer combination will provide more data points for finding dust storm patterns, chart weather changes, and provide Agnesi’s AI a warning if pressure becomes indicative of a dust storm. All instruments together will chart when pressures change with altitude and pressure in respect to wind speed. The chemistry objective will be met by a spectrophotometer and pulse laser combination. The spectrophotometer will provide scientists more accurate data of composition and allow determination of new substances based on their respective absorbances. The spectrophotometer will inundate soil samples with energy and measure the wavelength and frequencies of the energy released by the material. This will allow a very accurate inference of soil composition and density and provide input towards an area’s history and ergo Martian history.

The robotic mechanical arm consists of four segments all connected with motorized hinges and revolute joints akin to current Mars Rover ‘arm’ designs although this design allows the arm to reach every part of the rover in case a repair is required. At the common joint for the ‘claw’ exists a semi-autonomous camera unit that can provide distance measurements, automatically prevent overstressing the arm, and support detailed macrophotography. Embeded into the claw are sensors for pressure that can be used to confidently grab objects without applying to much pressure. Moreover, since the camera is so close to the object being grabbed, pictures can be taken and analyzed from up close.

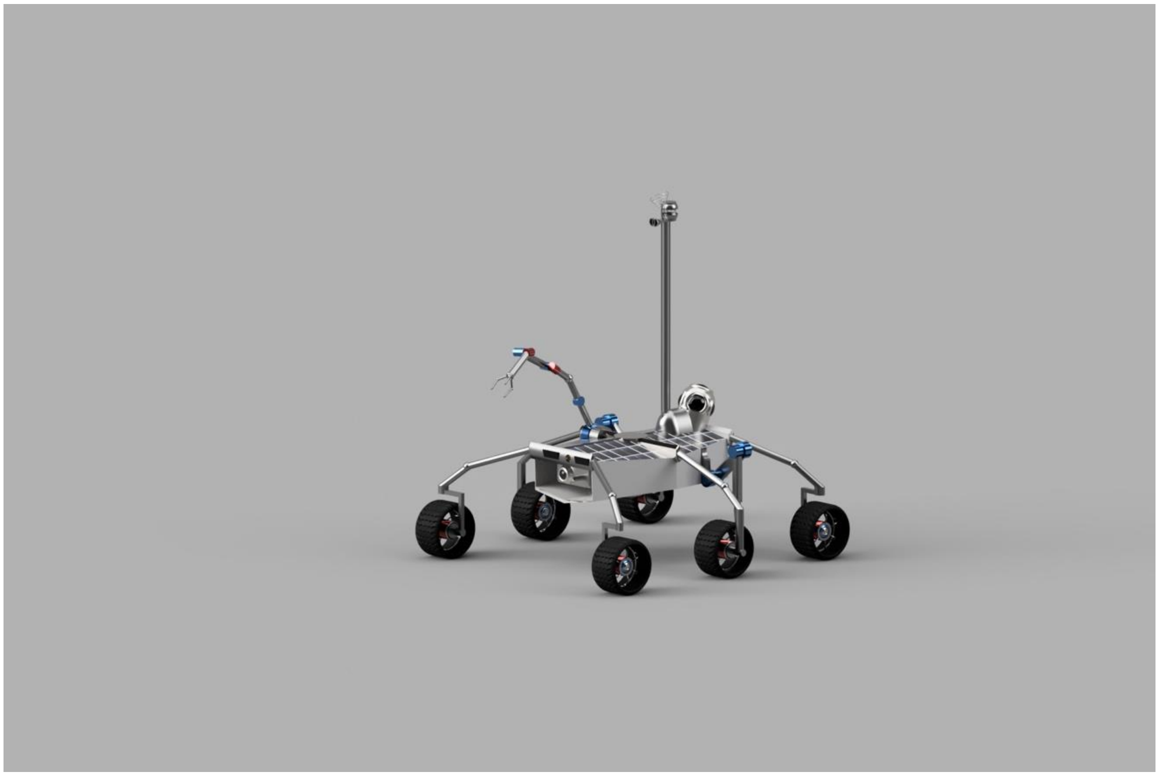
The computer system is nestled in Agnesi's immediate center and gives Agnesi the ability to work. There are identical three CPU's that rotate every day as to not over-work a single CPU. The central computer controls everything on Agnesi from tire speed to surveying and encoding pictures. The three solid state drives allow super-fast encoding of files and immense storage capabilities. The CPU handles a lot of information at once including monitoring the storm-warning system, controlling each wheel individually, and encoding data when necessary. In addition it regulates power output of the rover.

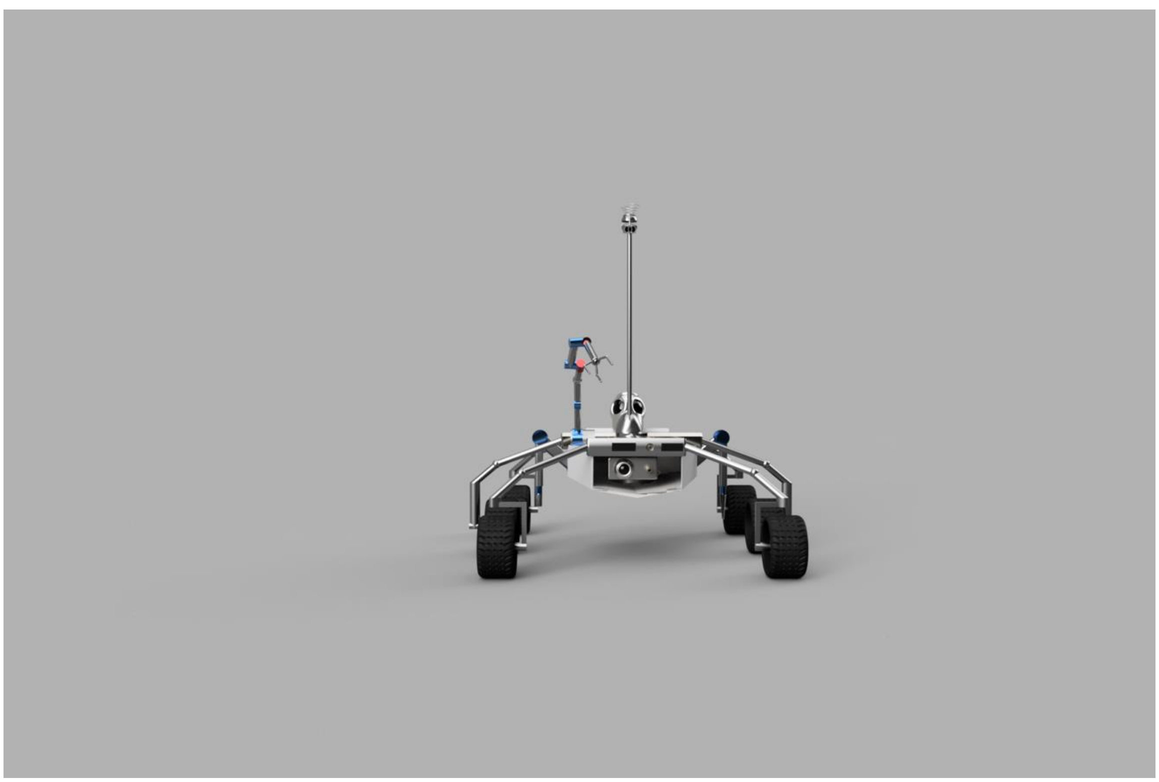
The communication system is relatively straightforward. The meter-long antennae is topped with a coiled 'dish' to further extend the communication signal. Here Agnesi will send the encoded files to MAVEN and from MAVEN it will go to earth and vice versa. Additionally, this antennae will carry navigation inputs from earth as well. Navigation hardware will include hazard and navigation cameras that are almost fully autonomous. They will exist on the front cross beam and have 180 degrees of vision from center. When Agnesi approaches a rock or crevice, it will simulate a path to avoid it and, if specific parameters are met, will be able to take the path without any human input. Otherwise, human input will be required. Perhaps most useful to the rover itself is that Agnesi will immediately map out this path for future reference and, barring interference, will automatically take the path whenever necessary. Due to the long delay of sending instructions between Earth and Mars, Agnesi may be temporarily put on Autopilot so long as the area is relatively free of debris.

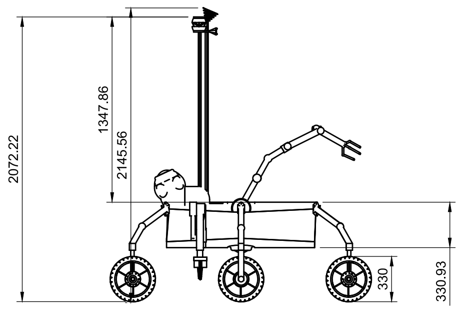
Agnesi, after the lauded 18^{th} century boundary-breaking woman mathematician, will find the best area for a permanent colony and once it has been found, will remain in that same area and continue to fulfill its objectives; continue to test, measure, and record.

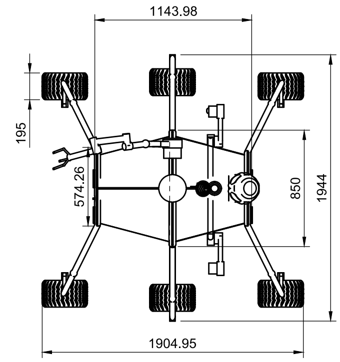
But once this area has been ascertained, Agnesi's will be able to fulfill the final part of its objective: allow those on Earth to experience Mars virtually. Using the data collected, the soil, wind, and chemical composition of Mars can all be taken into account when designing the habitat and make it perfectly suited for that environment. Then, NASA will be able to perfectly create the habitat's panels, screws, and components on Earth so that when colonists are sent to Mars they will have the perfect number, size, and kind of materials to build a home and thrive on Mars. This will be safer, save weight, and remove uncertainty of design from the equation because, after all, millions of people have designed it billions of times.

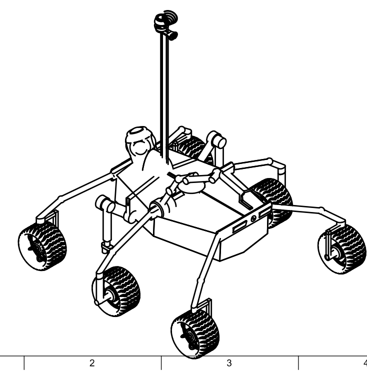
NASA Agnesi is more than just a rover that travels Mars. It is a rover looking for a home. It plays the role of surveyor, weatherman, designer, planner, and photographer. It is an idea turned into a dream turned into reality. Agnesi will have helped make that dream come true. A dream come true for humanity, a dream come true for those first colonists, and a dream come true for billions of people.











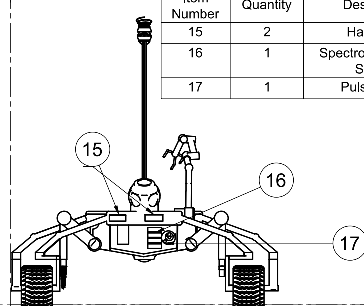
All Measurements in Millimeters

Dept.	Technical reference	Created by	Approved by
NASA		Basil Aranda 7/3/19	
		Document type	Document status
		Title: Agnesi Body Measurements	DWG No.
			Rev. / Date of issue / Sheet 1/1

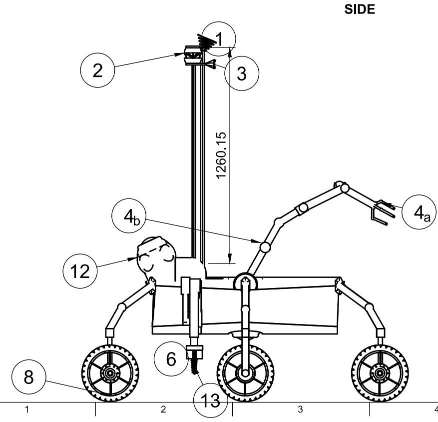
Item Number	Quantity	Description	Materials
1	1	Data Antennae	Gold,Rubber
2	1	Acoustic Anenometer	Titanium,Copper
3	1	Barometer/Altimeter	Computer Boards, Titanium
4a	1	Claw/Camera/Sensors	Titanium, Glass, etc.
4b	1	Arm	Titanium, Copper
5	1	360 Degree Camera	Polycarbonate, Computer Boards
6	1	Soil Sensors	Steel, Sensors
7	1	Drill	Titanium
8	6	Motorized Hub Wheels	Rubber, Titanium, etc.

Item Number	Quantity	Description	Materials
15	2	HazCams	Glass, etc,
16	1	Spectrophotometer Sensor	Glass, etc.
17	1	Pulse Laser	Glass, etc.

REAR

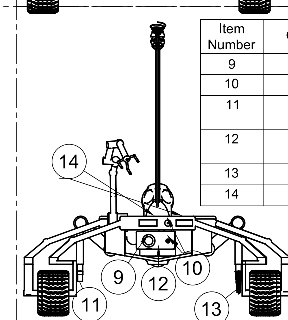


SIDE

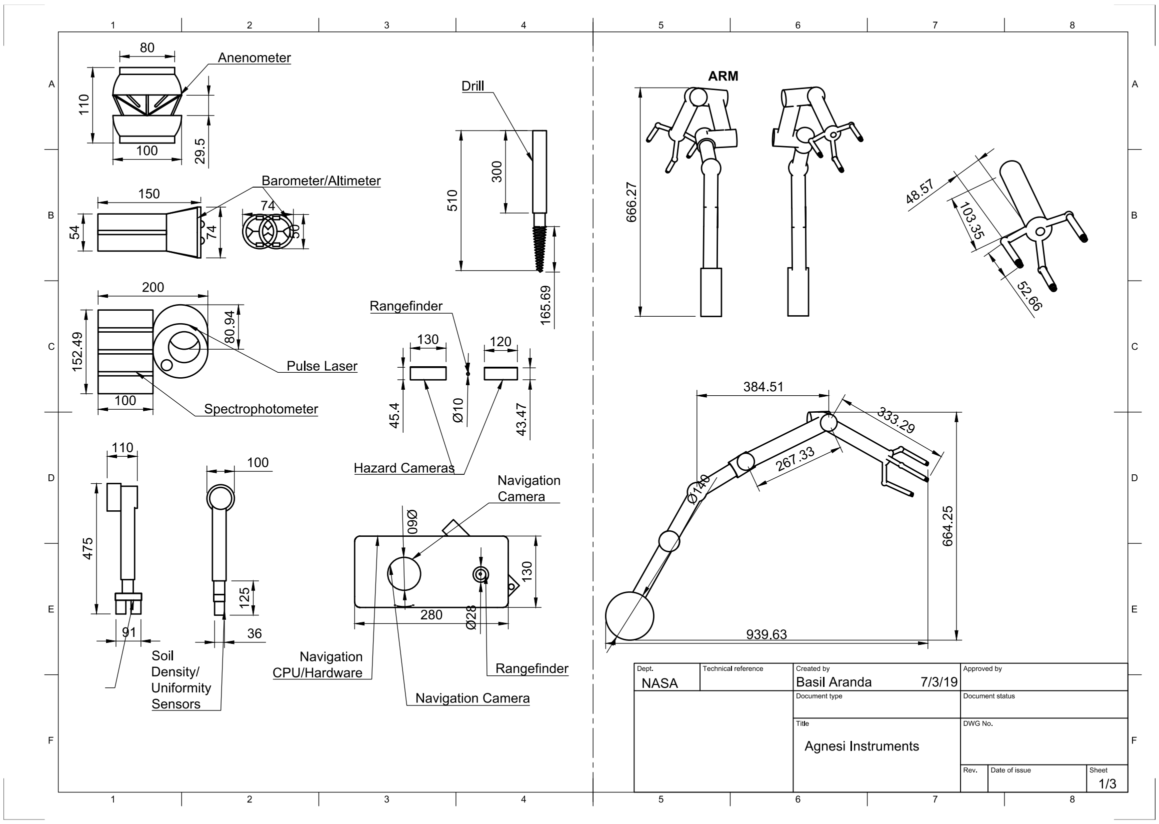


Item Number	Quantity	Description	Materials
9	1	NavCam	Glass, etc.
10	1	Rangefinders	Gold, Titanium
11	1	Pressure/Soil Sensors	Titanium, etc.
12	1	UnderCarriage Cam	Glass, etc.
13	1	Drill	Titanium
14	2	HazCams	Glass, etc.

FRONT



Dept.	Technical reference	Created by	Approved by
NASA		Basil Aranda	
		Document type	Document status
		Title: Agnesi Side Profile	DWG No.
			Rev. / Date of issue / Sheet 1/1


Anenometer
Barometer/Altimeter
Drill
Rangefinder
Pulse Laser
Spectrophotometer
Hazard Cameras
Navigation Camera
Soil Density/ Uniformity Sensors
Navigation CPU/Hardware
Rangefinder
Navigation Camera
ARM
Dept.
NASA
Technical reference
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Document type
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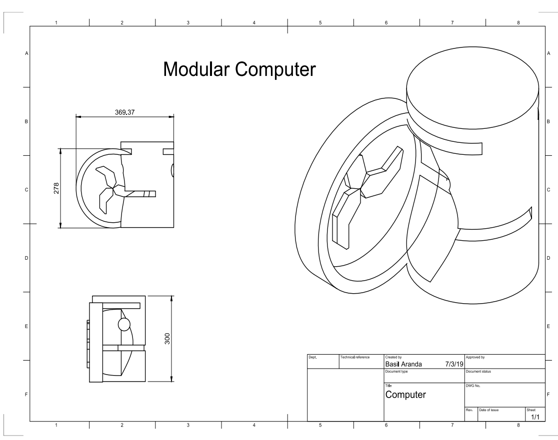
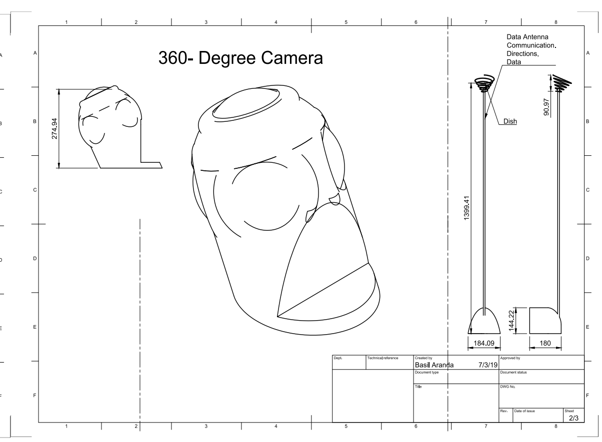
Title
Agnesi Instruments
DWG No.
Rev.
Date of issue
Sheet
1/3


Modular Computer
Basil Aranda
7/3/19
Computer
1/1


360- Degree Camera
Data Antenna Communication, Directions, Data
Dish
Basil Aranda
7/3/19
2/3

Works Cited

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2. “Metallurgical Materials Science and Alloy Design - Mechanical Properties of Titanium.” *Metallurgical Materials Science and Alloy Design - Mechanical Properties of Titanium*, www.dierk-raabe.com/titanium-alloys/mechanical-properties-of-titanium/.

3. Bpf. “British Plastics Federation.” *Polypropylene (PP)*, www.bpf.co.uk/plastipedia/polymers/pp.aspx#advantages.

4. “Mars.” *Scholastic*, www.scholastic.com/teachers/articles/teaching-content/mars/.

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6. “Erosion Rate.” *Erosion Rate - an Overview | ScienceDirect Topics*, www.sciencedirect.com/topics/earth-and-planetary-sciences/erosion-rate.