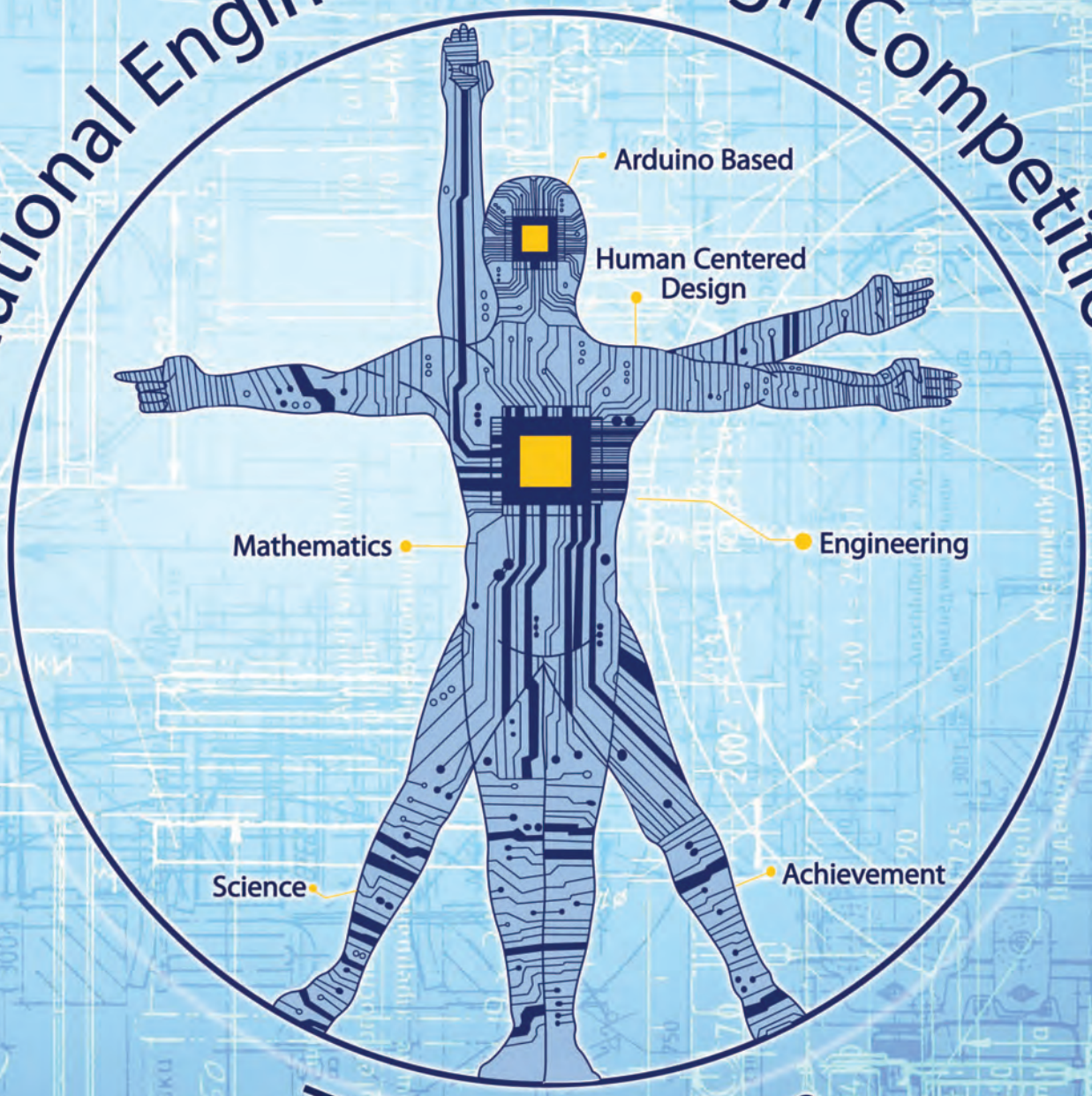
MESA®

Mathematics
Engineering
Science
Achievement

National Engineering Design Competition



Tucson, Arizona

2019

MESA
National Engineering Design Competition
2019

Contents

ABOUT MESA

Mathematics, Engineering, Science, Achievement (MESA) nationally is a collaborative K-16 STEM effort across ten states working towards equity and increased access to high quality STEM education and training for underrepresented students.

The MESA program was founded at Oakland Technical High School in 1970 with 25 students. MESA's goal was to develop academic and leadership skills, raise educational expectations, and instill confidence in California's students historically underrepresented in engineering, physical science, or other math-based fields, in order to increase the number of African American, Latino American and American Indian graduates from a four-year university

Since then, MESA has grown to become nationally recognized for its innovative and effective academic development programs. MESA engages thousands of educationally disadvantaged students in a multi-pronged approach to help them develop skills that will help them move forward on their educational pathways and toward undergraduate and graduate degrees in STEM fields. MESA has a proven track record with over 40 years in producing math-based graduates by providing support such as classes, hands-on competitions, counseling, transfer support and a community environment to students from middle school through four-year college.

Much of MESA's success arises from its ability to engage with partners in K-12, higher education, and STEM industries. These partners provide access, knowledge, time, talent, and financial support to ensure MESA is providing the most relevant and accessible program possible. For more, visit https://mesausa.org

MESA's Programs

- MESA Schools Program

The MESA Schools Program is a K-12 competitive STEM program offered afterschool in nine states. The program provides teacher training, academic tutoring, internships, field trips and pre-college pathways into STEM college programs. The MSP is hosted by an established state office (district, community college, university, or non-profit) that oversees the day to day operations of the program. Each approved host is expected to serve 50% or more students who are either 1) underrepresented in STEM careers (including girls of all backgrounds), or 2) attend economically disadvantaged schools.

- MESA Community College Program

The MESA Community College Program provides high school graduates with transitional support as they enter college. 70% of MCCP students are underrepresented minority or first-generation college students. MCCP students receive leadership training, tutoring, mentoring, academic counseling and recognition events to inspire success.

- MESA Engineering Program

The MESA Engineering Program offers retention support for first year students who directly enter a 4 year engineering program. Students identified as "at risk" because they lack strong math skills, or who are not familiar with engineering disciplines receive mentoring, academic tutoring, work study and additional services before, during and after admission to their engineering college. MEP is funded through grants, tuition revenue and donations.

MESA Quick Facts

- 10 states
- 49,000 K-14 students
- 1100+ Teachers
- 350+ School Districts
- 49 years of providing pathways to STEM for underserved students

MESA STATES

Arizona
- Executive Director – Rudy McCormick
- National Competition Rules Committee Representatives – Manny Leon & Bill Pike
- Website: http://azmesa.arizona.edu

California
- Executive Director – Thomas Ahn
- National Competition Rules Committee Representative – Carlos Gonzalez
- Website: https://mesa.ucop.edu/

Colorado
- Executive Director – Cynthia Howell, EdD
- Website: TBA

Maryland
- Executive Director – Dwight Carr
- National Competition Rules Committee Representative – Jason Cartwright
- Website: https://secwww.jhuapl.edu/MESA/

Nevada
- Executive Director – Rebecca Fisher
- National Competition Rules Committee Representative – Rebecca Fisher
- Website: https://www.unr.edu/engineering/k-12/mesa

New Mexico
- Executive Director – Toney Begay
- National Competition Rules Committee Representative – Anita Gonzales
- Website: http://www.nmmesa.org/

Oregon
- Executive Director – Tong Zhang, PhD
- National Competition Rules Committee Representative – Tamar Depue
- Website: https://www.oregonmesa.org/

Pennsylvania
- Executive Director – Jamie Bracey-Green, PhD
- National Competition Rules Committee Representatives – Jesus Davaloz and Victoria Carberry
- Website: https://pennsylvaniamesa.org/

Utah
- Executive Director – Charlene Lui
- National Competition Rules Committee Representative – Paul Ross
- Website: https://mesaut.org/

Washington
- Executive Director – Gregory King, EdD
- National Competition Rules Committee Representative – Debbie Blas

NEDC Overview

Arduino Based Solutions for Humans

The MESA National Engineering Design Competition 2018-2019 year, Arduino Based Solutions for Humans, asks students to implement the Human-Centered Design approach to find a client in their community who has a need, engineer a solution for this need using Arduino as the key component, and present their solution and recommendation(s) for next steps at the MESA USA National Engineering Design Competition.

MESA states may choose to keep the event open-ended or may require teams to focus on a particular area of need (i.e. agriculture, physical disabilities) or provide a specific client for teams to focus on at their state competitions.

The components listed below will be used to assess the effective implementation of a Human-Centered Design approach, effective implementation of the Engineering Design Process, the functionality of the prototype, and successful integration of Arduino as the main component of the prototype.

High school and middle school teams selected to participate at the national event will compete in the four components below:

1. Technical Presentation & Interview- The objective is to provide an overview of the prototype functionality including a technical explanation of the mechanical operations, software operations, and integration of the two. Students will prepare a short presentation and demonstration of the functionality of the prototype followed by a question and answer session with judges.

2. Poster & Symposium - The objective is to provide an overview of their project, highlighting key points of the design process including relevant data, presenting the resulting prototype, and share conclusions and recommendations for further development. Students will prepare a printed academic poster which can be used during a public poster symposium to provide an easily understood overview of the project and the prototype. The poster will also be required during the Technical Presentation & Interview.

3. Project Report - The objective is to provide an overview of the design process and demonstrate team's effective use of the Engineering Design Process. Students will write a 5-10 page report that contains their problem statement, summary of the design process, results, conclusion and next steps supported by pictures, charts, tables, and/or graphs. The report should be a journey through the design process and demonstrate key points of the process and why design choices were made. The report will have an appendix containing the commented Arduino code and detailed budget.

4. Prototype Pitch - The objective is to convince investors or management that the design meets the client's needs, is superior to other options available, and has business value as a product. Students will prepare a creative, engaging presentation to pitch their prototype to an audience, including a group of judges. The presentation should define the problem; provide a detailed description of their client and their needs; discuss current solutions to the problem and their weaknesses; provide a demonstration of their prototype highlighting its advantages, and demonstrate the business value of the product including a market analysis and marketing plan.

The first place middle and high school teams from state championships have traveled to the MESA National Engineering Design Competition. Each competing team consists of 3/4 students who are active members of a MESA program in their state.

Scoring Summary

Final team rankings will be based on the total score, which is derived by adding all of the component scores

Technical Presentation & Interview	100 points
Poster Symposium	50 points
Project Report	100 points
Prototype Pitch	100 points
Total	350 points

Awards for 1st through 3rd place will be awarded for each of the components listed above. Trophies for 1st through 3rd will be awarded for overall performance.

CODE OF CONDUCT

Although we know that our competitors are deeply invested in their projects we must remember that we are gathered in the "spirit of competition" to celebrate and support the mission of MESA and the future successes of our students. This event is an opportunity to embrace the work of all competitors to connect and learn from each other. However, in order to successfully facilitate the competition we must implement the following guidelines:

- The NEDC Rules committee and volunteer judges have authority to make all decisions regarding the facilitation of the competition.
- Decisions made by the committee and judges are final.
- Once a final decision is rendered, a student who attempt exhibits uncivil behavior about a decision, will be immediately disqualified from the event and scoring penalties may be assessed.
- Complaints may not be investigated nor will a ruling be changed once the MESA National Engineering Design Competition is complete.

There will be situations where students have questions about their designs that are related to the judging process. This is a wonderful opportunity for learning to occur and if approached appropriately, the judges will be asked to spend time with the students for discussion and design recommendations. In these cases, students should follow the guidelines below.

- Discussion and design questions should occur immediately after your performance and should pertain only to their project. Students should understand that judges may have other responsibilities that may limit their meeting time.
- Only the student competitor(s) can approach the judge for questions and feedback. Parents, other students, and MESA advisors should allow the student competitor(s) and judge(s) to conduct their discussion without interruption.

If you have questions or need clarification about this policy, please contact us at azmesa@email.arizona.edu. On behalf of MESA, thank you for your contributions, and we look forward to an exciting MESA USA National Engineering Design Competition!

Manny Leon, Rules Committee Chair

AGENDA

Wednesday, June 19

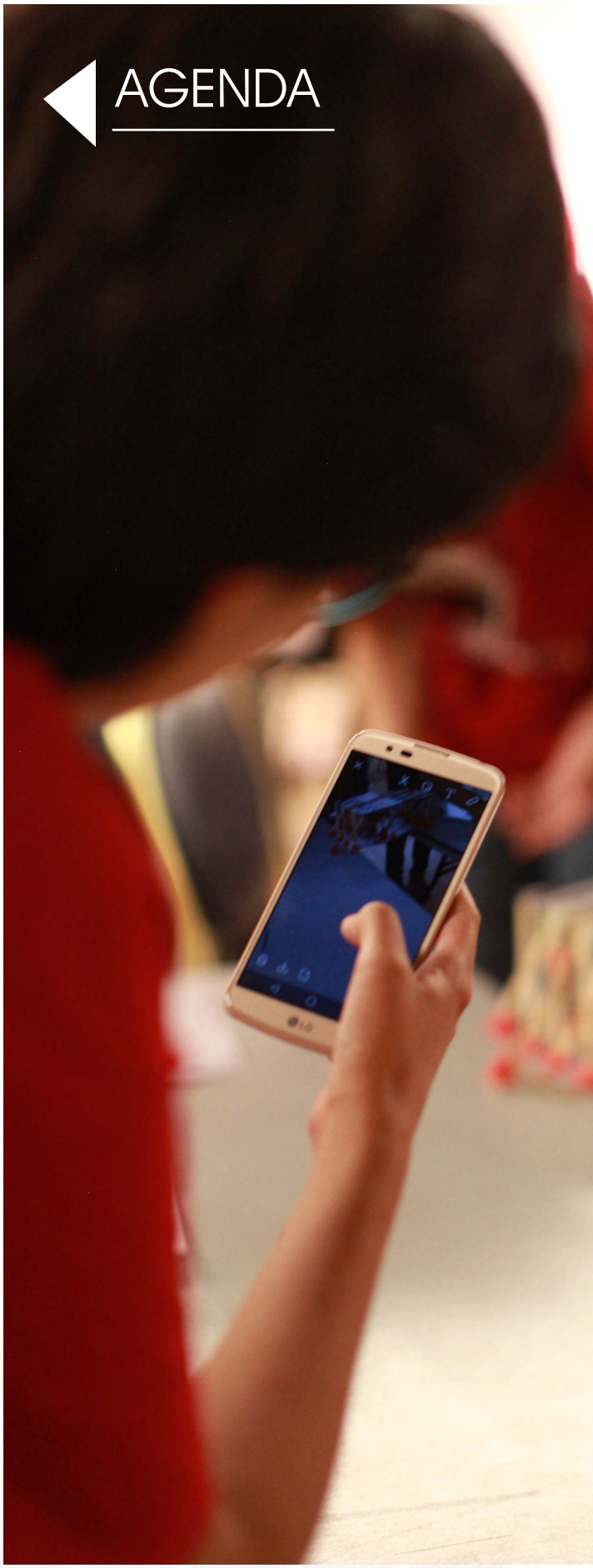
8:00 am – 9:00 am	Welcome Breakfast ENR2 S107
9:00 – 11:00	Travel to Biosphere 2
11:30 – 4:00	Technical Presentation and Interviews and Biosphere Tours, Lunch Biosphere 2, Oracle, Arizona
4:00 – 6:00	Travel to UA
6:00 – 8:00	Dinner on your own

Thursday, June 20

8:00 – 10:00	Breakfast on your own
8:30 – 9:50	Pitch Preparation ENR2 N120
10:00 – 12:00	Pitches – Middle School ENR2 N120
12:00 – 1:00	Lunch ENR2 Courtyard
1:00 – 3:00	Pitches – High School ENR2 N120
3:00 – 4:00	Poster Set-up in Courtyard
4:00 – 5:30	Poster Symposium ENR2 Courtyard Hors d'oeuvres in ENR2 Café Commons
5:30 – 6:00	Free time
6:00 – 7:00	Travel to Top Golf
7:00 – 9:00	Top Golf
9:00 – 10:00	Travel to UA

Friday, June 21

8:00 – 9:00	Convening Opening Breakfast* - Ruthe Farmer, Computer Science for All – Keynote ENR2 N120
9:00 – 10:00	State of MESA USA Presentation – Report by Executive Directors on where MESA is as an organization, and thoughts about the future direction as we head into our 50th year ENR2 S107
10:00 – 11:30	MESA State Best Practices Sessions (30 minute STEM Talks) – each state will have the opportunity to share best practices, in hopes that we can strengthen the efficacy of MESA by building on individual successes. ENR2 S107, S210, S215, S225
11:30 – 12:30	Lunch ENR2 Courtyard, S107
12:30 – 1:30	Industry Panel presents on the future needs of the Industry ENR2 S107
1:30 – 3:00	Charting the Course Discussions – Break-out sessions where all participants will be able to engage in conversations to provide MESA with pertinent information to help guide the direction of the organization. ENR2 S107, S210, S215, S225
3:00 – 4:00	NEDC Awards, End of Event ENR2 N120



ARIZONA TEAM

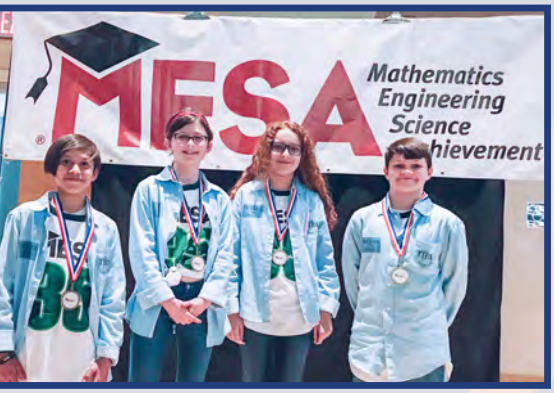
Team Members: Rojina Khatri, Nadira Mitchell, Moses Osuna, George Testo
Team Advisor(s): Sheila Marquez, Gladys Amaya

Project Title: Cost-Effective Hydroponics System for Self-Sufficient Living

High School Name: Tucson High Magnet School

Project Goal: To design a prototype hydroponic system that monitors pH.

Project Abstract:
Many local residents of Tucson have expressed an interest in growing their own food locally but the lack of space and their determination to live a more self-sufficient lifestyle dictates whether or not they can have their own garden. Our very own client, Jeremy Jonas, a biotechnology teacher at Tucson High Magnet School, expressed the want for a hydroponics system (similar to many Tucsonans) that is affordable, self-sufficient, portable, and easy to maintain. We utilized plastic containers, a pH sensor, float switches, and Arduino in order to create our hydroponics system prototype. The system utilizes a continuous flow and drain system, which requires the use of a submersible pump within a reservoir that transports a solution of water and nutrient mix into a plant container above the reservoir. This flow and drain system that we based our project on makes it easy to refill and the two float switches are used to ensure that the system does not run when either the plant container is about to overflow or there is no water in the reservoir. The system uses a pre-programmed pH meter to collect pH values, which are sent to the Arduino microcontroller allowing little to no interference from the user. This system provides the user with a cost-effective solution to growing food in a limited space without worrying about the health and maintenance of their plants.



Team Members: Thomas Beltran, Isabel Cardenas, Brenan Wesolek, Ana Fritts
Team Advisor(s): Rowe Van Meter

Project Title: TIBA H2.O

Middle School Name: Rogers Ranch

Project Goal: To design a water bottle koozie (holder) that reminds the user to drink water and improve their hydration.

Project Abstract:
Over seventy five percent of the population is dehydrated leading to health problems such as dizziness and headaches, and in extreme cases trips to the emergency room or death. Women need to drink over one half a gallon of water a day and men one gallon of water a day, but in our busy lives it is difficult to remember to stay hydrated.

The TIBA H2.O is a water bottle koozie, or holder, that holds the water bottle you already use and reminds you to drink. The koozie is made of recycled plastic water bottles and covered in foam for insulation. Inside the base of the koozie is an Arduino microcontroller which programs the three drink reminders: an LED flashing light, a vibration motor, and an alarm buzzer. The user can program the device to remind them to take a sip of water using one, two, or all three of the reminders at the time interval the user selects. We recommend every three minutes for men and four minutes for women based on fluid intake suggestions. Finally, the user can sync the TIBA H2.O with an app (currently in development) where they can monitor their hydration progress and set goals.

CALIFORNIA TEAM

Project Title: Respiratory Local Air Quality Sensor

High School Name: Oxnard High School

Project Goal: Develop a design to provide reliable air quality information for community use

Project Abstract:
In late 2018, Southern California experienced devastating wildfires that affected the health and livelihood of everyone in our community of Ventura County. School districts relied on air quality websites to determine if students should attend classes that day. The websites were unreliable and gave air quality information for a general region rather than a more specific area (i.e. Ventura County v West Oxnard), creating flawed data that proved inadequate for these critical decisions, putting the health of students and staff at a much greater risk. In response to this problem, we as Team Aero engineered an air quality sensor, Respiratory-Local Air Quality Sensor (RE-LAQs) to provide immediate air quality information for our local area, mitigating misinformation about air quality.
The Re-LAQS systems was developed to meet the needs of our local community. It integrates an Arduino Pro Mini with a PM2.5 (particulate matter 2.5 µm) and a gas sensor, which cooperate to detect dangerous levels of particulate matter and toxic gases. Upon detection, users are alerted with visual and audible cues, and transmitting the data to the Team Aero App. We are currently working with community experts to create a better product, including miniaturizing the design and creating a custom printed circuit board.

Team Members: David Pulido, Sara Centeno, Carl Vincent Cuyos, Jenna Huynh
Team Advisor(s): Nicholas Peterson, Rocio Mora

Project Title: Automated Fish Feeding Apparatus (A.F.F.A.)

Middle School Name: Mendota Junior High School

Project Goal: To design a reliable automatic fish feeder which eliminates the need for manual feeding.

Project Abstract:
Our STEM advisor is required to manually provide food daily for the fish in the aquaponics system. If he is not available to complete this task due to an emergency or special occasion, the fish will die resulting in a disruption of the aquaponics cycle.

The intended solution for this problem is the Automated Fish Feeding Apparatus. This device will be a crucial part of the STEM program's aquaponics system. It will eliminate the need of our advisor to feed the fish manually. We have included additional features for the user to simplify other routine tasks such as monitoring refill time, temperature and humidity sensors, and a user-friendly graphical menu with visually-appealing momentary switches to make the device visually appealing. The user will have the ability to modify rotation periods from the LCD menu using momentary switches as their personal aquaponics system will likely require a specific feeding schedule. When the device is active, it will alert the user of the amount of food remaining in the canister by emitting green, yellow, and red LEDs. The prototype involves the use of ABS Pipe, PLA, a VEX 3-Wire servo, Arduino Nano, Arduino UNO R3 and VEX sprockets to create a sturdy and reliable feeder. Our client will rest easy knowing the fish are fed.

Team Members: Alex Cruz, Alejandro Oseguera, Jonathan Rivera, Bryan Torres
Team Advisor(s): Maxwell McDougal, Carlos Tamayo

MARYLAND TEAM

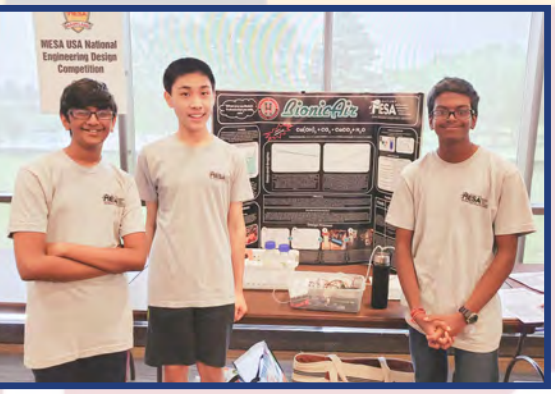
Team Members: Christopher Tan, AJ Saquilayan, Aneisa Jangbahadur, Hana Harwood
Team Advisor(s): Angela Waldrop

Project Title: The Mobility Pod

High School Name: Eastern Technical High School

Project Goal: To create a device that would make it easier for the visually impaired to navigate foreign environments.

Project Abstract:
Mr. Craig Borne, a family friend of Chris Tang, lost his vision during adulthood causing him to rely on the assistance of his service dog to walk. Unfortunately, his service dog passed away forcing him to revert to using the traditional mobility aid. The proposed solution is a pod that would attach to the bottom of the mobility aid allowing the user to obtain a better sense of their surroundings through audio and vibrating outputs. It will help the client to detect his or her proximity from obstacles and will eliminate the fear that exploring unfamiliar environments induces.



Team Members: Kevin Song, Sai Divvela, Pranav Bonagiri
Team Advisor(s): Mr. Dustin Deem

Project Title: BionicAir

Middle School Name: Hallie Wells

Project Goal: The goal of BionicAir is to reduce the effects of Global Warming by decreasing the unsafe
amount of CO2 in our atmosphere.

Project Abstract:
The current global atmospheric CO2 levels of 415 ppm have exceeded the safe zone of 315 ppm, and it's continuing to rise at 3 ppm per year! In about 40 years, our CO2 levels will match up with levels last seen in the Permian Extinction, also known as the "Great Dying."
BionicAir is the perfect solution to one of humanity's greatest problems. The BionicAir CO2 filter is comprised of an air pump, glass water bottle, CO2, temperature, humidity, pH sensors, an Arduino board to collect data from the sensors, a Bluetooth module to output the sensors' data to an external device (in this case an iPad) through a mobile app, a buzzer, and a solar power module to power the air pump. To filter the air of CO2, we use an aqueous solution of calcium hydroxide & water. This solution reacts with CO2 and converts them into limestone and water. In our experiments, we discovered that the pH level of the aqueous solution directly indicates how much calcium hydroxide is left within BionicAir. The BionicAir pH sensor monitors our aqueous solution so that when a user needs to add more calcium hydroxide, BionicAir will sound a buzzer to alert the user. A user of BionicAir would be provided with a simple interface on a mobile device for monitoring the data collected by the sensors. BionicAir is built to be user-friendly, green, cost-efficient, and powerful at removing CO2 through its low-cost parts, practical solution, and simple usability.

NEW MEXICO TEAM

Project Title: Automated Retractable Hoop House

High School Name: nex+Gen Academy High School

Team Members: Carly Salazar, Jesus Aguilar, Zephan Heisch, Callum Tobias
Team Advisor(s): Laura White

Project Goal: To design a prototype automated retractable hoop house which if developed fully would make a neighboring elementary school garden more sustainable, combating food insecurity in our community.

Project Abstract:
One out of four New Mexico children are living in poverty. Our goal is to combat food insecurity in our community by increasing the access of children to fresh produce. We aim to do this by bringing sustainability to an elementary school garden with a large demographic of impoverished children. We designed an automated retractable hoop house that regulates the internal growing temperature of a garden bed by opening and closing in response to the external temperature. Our design utilizes a temperature sensor and stepper motor that work in conjunction with one another to open or close the hoop house cover to protect the plants within from harmful desert temperature swings during the winter and summer months. This will in turn extend the growing season and allow greater access to fresh produce by increasing the yield of the school garden. This design is customizable to any garden bed or climate, by manipulating the size, cover material, and opening and closing temperature thresholds. After a one time installation by the team, the user is provided with a fully automatic temperature regulating environment. Twice a year an additional service may be provided to change over the code and cover fabric to suit the season.

Project Title: Biddle Products Introducing the Smart Spoon and Smart Liquid Alert for the Visually Impaired

Middle School Name: Chaparral Middle School

Team Members: Elias Galvan, Isaac Garcia, Alyssa Sandoval
Team Advisor(s): Rina Viramontes

Project Goal: Our goal is to provide the visually impaired with a spoon that will allow them to know when it has food on in it. We also want to provide them with a way to know if their cup of full in order to avoid spillage.

Project Abstract:
Our classmate, Mickayla Biddle, has been blind since birth. She asked us to help her with two specific problems: first she no longer wanted to have to use her finger in order to know when there was food in her spoon and two she also did not want to use her finger to know when her cup was full. She wanted a more sanitary way to eat.
Our team set out to help Mickayla using the Human-Centered Design Approach. We found that there were no spoons that accomplished this purpose. We did find liquid level indicators, but none of them were non-contact making it less sanitary.
The Biddle Smart Spoon consists of a sensor, buzzer and Arduino. The sensor detects food on the spoon and the Arduino turns the buzzer on. The Biddle Smart Spoon was 3D printed with a sleek and ergonomic design. It is simple to turn on and off and replace the batteries, characteristics that were important for our client.
The Smart Liquid Alert consists of a non-contact water sensor, buzzer, Arduino, elastic and 3D printed box casing. The elastic allows the box to be attached to different size cups. Once water reaches the desired height, the buzzer will go off and the box can be turned off. The box is detachable which allows the cup to be cleaned.

OREGON TEAM

Team Members: Ezra Baker, Ricky Mesa, Melissa Tran, Conall Anderson
Team Advisor(s): Suzanne Pittock

Project Title: Test Anxiety Relief Folder

High School Name: Meadow Park High School

Project Goal: We want to design a device that can address a student's test anxiety while they are taking a test.

Project Abstract:
Our client, Tony, is an 8th grade student with test anxiety. When Tony takes a test, he can experience an anxiety attack, causing uncomfortable symptoms like lightheadedness and an elevated heart rate. Tony is part of the 36% of students in the United States who have moderately high test anxiety, a number that will only increase as more emphasis is put on standardized tests throughout a student's education. Across every school in the United States, students are unable to perform well on the tests that will influence their college and job applications, not because of a lack of knowledge, but because of text anxiety. No current device on the market is specifically designed to address test anxiety, leaving students on their own to deal with their stress during a test. In order to relax the user, our design guides breathing through a light strip that moves up and down. To activate the guided breathing, the user places their finger on an Arduino heart rate sensor. We use a Bluetooth module to send the heart rate data to the teacher's computer, where BPM over time is shown in a graph. The teacher can use this data to know when to reassure a student, extend the length of a test, or change how they plan tests in the future. The user can take their finger off at any point and stop the device. The entire device is integrated with a testing folder, making it more subtle in a testing environment.

Team Members: Linna Hopper, Elsa Warner, Ada Currey, Frankie Silverstein
Team Advisor(s): Frank Fields

Project Title: The Communication Book

Middle School Name: Mt Tabor

Project Goal: With our project, nonverbal students and students who have difficulty expressing their needs will be able to communicate with the teacher efficiently and privately.

Project Abstract:
Our client is Mr. Speer, a special education teacher at Mt. Tabor Middle School. All of his students have different needs and talents, but our project focuses on those who have trouble communicating. With our project, nonverbal students and students who have difficulty expressing their needs will be able to communicate with the teacher efficiently and privately. Mr. Speer told us that one of the students in his class can't speak and is limited to small movements In her arm and fingers. This meant our project couldn't require a voice or fine motor skills. Another limitation was that Mr. Speer found it very important that the project blended well into a normal classroom setting. It couldn't be distracting, which led us to think of "disguising" it as a common item (a book). Furthermore, it had to be transportable, since many of his students don't stay in his classroom. A common class for them to have is P.E, where everyone throws their supplies into a pile on the floor. This meant our project had to be durable since heavy bags and binders might be dropped on it. In addition, we were required to use Arduino. Using these facts, we began to develop our product, while focusing on its need to be durable, accessible, portable, and engaging.

PENNSYLVANIA TEAM

Project Title: The Future is Vertical

High School Name: Northeast High School

Project Goal: To design and build an indoor hydroponic garden for urban families

Project Abstract:
Many families in Philadelphia and around the world are victims of unhealthy diets. This is not because they do not have access to a healthy lifestyle, but because healthy options are costly compared to unhealthy eating options . Current market solutions do not offer an ecologically sustainable and cost-efficient method to attain healthy food to support households. We wanted to offer a cheaper solution for the urban residents by decreasing distance and wastage , which led to building an indoor hydroponic system.
Our prototype consists of a combination of vertical hydroponics and a drip irrigation system that maximizes food production at a low cost. It consists of ten vertical towers with leakage free piping system all around the prototype to reduce water wastage along with an Arduino control which ensures normal pH and temperature for plant growth. The prototype produces zero waste, has minimal to no water wastage and fertilizer use. It also consumes minimal space and reduces distance and manual labor when compared with conventional agriculture and hydroponics.

Team Members: Aneela Alex, Suliman Alaud, Chenling Huang & Fiyin Akinnodi
Team Advisor(s): Mr. Adams, Mrs. Stratton

UTAH TEAM

Team Members: Vincent Chang, Jeff Chen, Soonyoung Kwon, Daniel Liu
Team Advisor(s): Mr. Jasumback

Project Title: Soil Moisture Meter
High School Name: Skyline Highschool

Project Goal: To create an Arduino monitoring device that helps homeowners optimize water usage for their lawns, in order to reduce water waste while still maintaining a healthy lawn.

Project Abstract:
Drought and water shortage is a massive issue in Utah. Water is an already scarce resource that is further wasted by inefficient homeowner lawn watering practices. We wanted to create a device that would be able to reduce the client homeowner's water usage while being affordable, multifunctional, and easy to use.
The Soil Moisture Meter is an Arduino device that uses a collection of probes to monitor and gather information about the homeowner's lawn. Each probe contains several sensors that gather important information when inserted into the soil of the lawn. The probes then send the data to a central control device housed within the customer's home. Using the data collected from the probes, our central control device is able to calculate when, how much, and with what frequency the homeowner should water their lawn. These instructions are then relayed to the homeowner through a custom, easy-to-use app that the homeowner can install on their Bluetooth-enabled device. The instructions and information can also be accessed through the central control device where information is relayed through the LCD screen. Using these simple instructions, the homeowner can efficiently water their lawn, saving resources and reducing environmental impact.

Team Members: Kalista Leggitt, Ava Curtis, and Caidence Openshaw
Team Advisor(s): Chris Reisinger

Project Title: Lighting the way to a darker future
Middle School Name: Bennion Jr. High

Project Goal: To provide the most environmentally stable solution to street light pollution.

Project Abstract:
Currently used street lights emit high levels of light pollution which can lead to melatonin suppressions, and ecological harm. Our street light replacement consists of an arduino light sensor, and a low pressure sodium bulb. Along with wiring a protector. The light sensor allows our light to turn off and on, with the sun, and therefore, requires no adjustment or maintenance. Furthermore, how much light it requires to turn on is an adjustable variable that can be changed based on location. The LPS light produces a light that is monochromatic allowing for a decrease light pollution primarily caused by blue light. Unlike other solutions, such as black light, it's relatively easy on the eyes, and still produces enough light. The client would simply need to install the bulb, and the connected wiring and sensor, and then the product runs on it's own with no need for the client to do anything. Therefore, our product meets our clients needs of safety, sustainability, and ease of use.

WASHINGTON TEAM

Project Title: B-Safe

High School Name: Chiawana High School

Project Goal: To create a fully-functional, compact, user-friendly product that can increase the safety of bike riders by using a series of sensor devices to help prevent or reduce most bicycle-automobile related accidents.

Project Abstract:
Approximately 6.5 million Americans ride bikes and 21,976 of them were involved in accidents causing either injury or death. B-SAFE helps to reduce or prevent the number of people being injured from bike accidents by using a series of devices created. We improved last year's design and created a fully functional, wireless, more compact, user-friendly prototype with many improved and new features. It is compact and it can fit on any bike frame, thus increasing its versatility. B-SAFE can alert riders of oncoming traffic by utilizing ultrasonic sensors and an automatic braking system to stop the bike, preventing the bike from running into traffic; it uses a compact, LED blinker light design that is controlled by an app we developed; it has rechargeable, color responsive side lights using photo resistive sensors; a new security system using a gyroscope sensor; and we developed an app to control the Arduino microcontrollers and components also allowing voice commands.

Team Members: Leslie Perez, Lucio Rodriguez, Ali Cortez, Geovanni Beltran
Team Advisor(s): Jeff Albertsen, Elizabeth V Stephens

Project Title: The Food Level Control System (FLCS)

Middle School Name: Hazel Wolf K-8

Project Goal: Our product would help make it so that no animal starves, and the owner is reminded to feed their animal.

Project Abstract:
The Food Level Control System (FLCS) makes the happiness of your pet easily achievable. Our client, Rose Palmer, owns a feeder and cage for her pet rabbit, Bun Bun Moo Galileo. Bun Bun Moo Galileo and other animals deserve a constant food supply, but our client was struggling to know when her bunny needed more food with an opaque feeder.

We strived to design a product that included an indicator to let her know when the food level was getting low. Using an infrared sensor, we would detect when food was no longer obtainable for the animal. When this happens, the LEDs would turn from green to red. Within our tests, the infrared sensor responded as desired. When there was food in front of the sensor, or there was enough food, the green light was on. When there was no food in front of the sensors, or there was not enough food, the red light went on. This provided a clear visual of what our product should look like when given to our client. Our final design includes an infrared transmitter and receiver, two LEDs (one red one green), a PVC pipe, a PVC elbow, a 3D printed box to hold the red board, soldering board, and wires. These combine to make our design a life changing experience for both the pet and its owner.

Team Members: Vida Rack, Summer Lombard, Madeleine Bruce, Nico Saenz
Team Advisor(s): Beverly Ferguson

GENERAL INFORMATION

Welcome to Tucson, Arizona!

For authentic Southwestern experiences, Tucson (and surrounding Southern Arizona) fits the bill.

Guest ranches, horseback rides, and cattle drives recall Old West roots, but you'll also find yourself smack-dab in a hub of spas, resort hotels, and championship golf courses...not to mention amazing, trend-setting restaurants. Tucson was the first city to earn the designation of World City of Gastronomy by the United Nations Educational, Scientific, and Cultural Organization (UNESCO). Plus, with a thriving visual and performing arts scene and respected galleries and museums, Tucson's vibrant multicultural heritage shines.

Famous for its dramatic beauty, the Sonoran Desert covers this region with spectacular cacti – including the giant saguaro, a symbol of the American Southwest. But don't be fooled by the term "desert" because mountain ranges in all directions offer scenic drives, and even snow skiing. In the winter you can go for a hike in the valley, then drive up to Mt. Lemmon and enjoy the slopes. Tucson's legendary year-round sunshine and saguaro-and-sunset landscape have romanced visitors for decades.

Once you immerse yourself in the laid-back atmosphere of Tucson, you may never want to leave.

- https://www.visitarizona.com/cities/tucson-and-southern/tucson

More about Tucson from the Tucson Visitor's Center (http://visittucson.org)

- The name Tucson itself comes from the Hohokam words "chuk shon," roughly translating to 'at the foot of the black mountain', referring to dwellings by Native Americans that have called this area home for more than 4,000 years. That makes this one of the oldest continually inhabited areas in North America! The modern era of Tucson's history began on August 20, 1775, with the founding of Presidio San Agustin del Tucson by Spanish settlers who first arrived in the late 1600s, having built Mission San Xavier del Bac.

- Tucson, with more than 340 days of sunshine a year, is primarily a dry climate, thanks to our location in the middle of the desert. Our monsoon rainy season stretches from mid-June through mid-September, producing epic thunderstorms and microbursts. Most of the year we've got plenty of sunshine and opportunities to explore the desert or hang out by the pool.

- In December of 2015, UNESCO (United Nations Educational, Scientific and Cultural Organization) named Tucson as the first city to be named a City of Gastronomy in the United States. Much more than a nod to our spectacular Mexican cuisine, it's a comprehensive award that encompasses "our region's rich agricultural heritage, thriving food traditions, and culinary distinctiveness."

About the University of Arizona (https://www.visittucson.org/visit/around-tucson/district/university-arizona)
Covering 380 acres in midtown Tucson, the university dates back to 1885—before Arizona was a state and long before mascots Wilbur and Wilma Wildcat cheered a "Bear Down, Arizona!" chorus. But there's nothing old-fashioned about this leading public university. It's a hub of community activity, like a walkable mini-city where you can experience the arts and humanities, learn about scientific discoveries, rally at athletic events, marvel at modern architecture, and stroll nature paths. Academically, the University of Arizona is a global leader in both science and the arts. Nicknamed Science City, the UA is a longtime partner of NASA and a center of world-renowned observatories that has been at the forefront of modern astronomy and space science for decades . The two UA medical schools rank among the nation's best and are transforming

academic medicine with innovative research, while the UA BIO5 Institute is the national epicenter of collaborative research on biology-based challenges. And, the university's top-rated theater, film, photography, and dance programs are a source of outstanding yet affordable student performances, exhibitions, and screenings.

The UA has nine family-friendly museums—ranging from anthropology to photography—where the curious of all ages can soak up science and culture.

National Competition Venues
Biosphere 2 - https://biosphere2.org/
The Biosphere 2 facility serves as a laboratory for controlled scientific studies, an arena for scientific discovery and discussion, and a far-reaching provider of public education. Its mission is to serve as a center for research, outreach, teaching and life-long learning about Earth, its living systems, and its place in the universe; to catalyze interdisciplinary thinking and understanding about Earth and its future; to be an adaptive tool for Earth education and outreach to industry, government, and the public; and to distill issues related to Earth systems planning and management for use by policymakers, students and the public.

ENR2 - https://www.environment.arizona.edu/enr2
Completed in 2015, ENR2 is part of the University of Arizona's commitment to environmental sustainability and interdisciplinary research and studies that focus on earth science, environmental programs, and natural resources. The building contains offices, classrooms, auditoriums and gathering rooms for public programs, in addition to a café and a stunning central courtyard that foster circulation and gathering. IE shares the five-story structure with the School of Geography and Development, the School of Natural Resources and the Environment, the Institute for Energy Solutions, Office of Sustainability, and some divisions of the Department of Mathematics. The LEED platinum-certified building incorporates cutting-edge technologies that epitomize the UA's dedication to sustainability in higher education.

For more information on the University and surrounding areas:

1. The University of Arizona – http://arizona.edu
2. The University of Arizona Map - http://map.arizona.edu
3. Places to eat at The University of Arizona - http://www.union.arizona.edu/dining/sumc
   Cactus Grill 8 AM – 2 PM
   Chick-Fil-A 10:30 AM-5 PM
   Einstein Bros Bagels 7 AM-3 PM
   IQ Fresh 8 AM-3 PM
   NRICH Urban Market 7:30 AM-3 PM
   On Deck Deli 10:30 AM-3 PM
   Panda Express 10 AM-6 PM
   Papa John's Pizza 10 AM-6:30 PM
   Sabor 11 AM-2 PM
   Starbucks @ Bookstore 8 AM-7 PM
   Steak N Shake 10 AM-6 PM
   the scoop 7:30 AM-3 PM
   U-Mart 7:30 AM-9 PM
   Bear Down Kitchen @ Arizona Stadium 7:30 AM-12 PM
   Highland Market 7 AM-2 PM
   Slot Canyon Cafe 7:30 AM-5 PM
   Starbucks @ the Library 7 AM-5 PM

GENERAL INFORMATION CONT...

4. Main Gate Square - https://www.maingatesquare.com/

CAFÉ'S, DESSERTS & COFFEE

Caffé Lucé 7AM – 10PM
Campus Candy & Yogurt 11AM – 10PM
Dunkin Donuts/Baskin Robbins 6AM – 9PM
Espresso Art 8AM – 2AM
Jamba Juice 8AM – 5PM
Scented Leaf Tea House & Lounge 9AM – 9PM
Starbucks Coffee 5AM – 8:30PM
The Dutch Eatery & Refuge 9AM – 9PM
Woops! BakeShop 7AM – 10PM

RESTAURANTS

Americano Mexicano 11AM – 10PM
Chipotle Mexican Grill 10:45AM – 10PM
Geronimo Restaurant 7AM – 3PM
Jimmy's Pita & Poke 10AM – 9PM
Frog & Firkin 11AM – 2AM
Fuku Sushi 12PM – 12AM
Gentle Ben's Brewing Co. 11AM – 2AM
Illegal Pete's 10:30AM – 12AM
Jimmy John's 11AM – 3AM
Kababeque Indian Grill 10AM – 10PM
No Anchovies 11AM – 2AM
Oriental Express 11AM – 2PM
Panera Bread 6AM – 9PM
Pei Wei Asian Diner 10:45AM – 8PM
Pelio Grill 11AM – 9PM
Saguaro Grill (Marriott Tucson University Park Hotel) 6:30AM – 10PM
Saigon Pho 11AM – 9PM
Sinbad's 10:30AM – 12AM
The Buffalo Spot 10:30AM – 1AM
The Dutch Eatery & Refuge 9AM – 9PM

PHARMACY

CVS Pharmacy Open 24 hours

5. Historic Fourth Avenue (dining and shopping)- https://fourthavenue.org/
6. Downtown Tucson (dining and shopping) - https://www.downtowntucson.org/
7. Sunlink Streetcar (transportation)- https://www.sunlinkstreetcar.com/

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Raytheon

Raytheon Company is a technology and innovation leader specializing in defense, civil government and cybersecurity solutions. Founded in 1922, Raytheon provides state-of-the-art electronics, mission systems integration, C5I™ products and services, sensing, effects and mission support services. Raytheon is headquartered in Waltham, Massachusetts.

Microsoft

Microsoft (Nasdaq "MSFT" @microsoft) enables digital transformation for the era of an intelligent cloud and an intelligent edge. Its mission is to empower every person and every organization on the planet to achieve more.

Microsoft refers to Microsoft Corp. and its affiliates, including Microsoft Mobile Oy, a subsidiary of Microsoft. Microsoft Mobile Oy develops, manufactures and distributes Nokia X mobile phones and other devices.

NOTES

https://mesausa.org