INSPIRE
INTERACTIVE NASA SPACE PHYSICS
IONOSPHERE RADIO EXPERIMENTS

The INSPIRE Journal

VOLUME 24 SUMMER 2019

A publication of The INSPIRE Project Inc.

Contents

The INSPIRE Journal is a publication of The INSPIRE Project Inc., a 501(c)(3) nonprofit educational scientific corporation (FEIN 95-4418628). Letters and submissions for *The INSPIRE Journal* should be emailed to: Editor@TheINSPIREProject.org

INSPIRE'S LEGACY
Dr. William (Bill) W. L. Taylor was a leader in the field of space science education and public outreach. He co-founded and was president of INSPIRE, one of the pioneering successes in NASA Sun Earth Connection Education. NASA Goddard Space Flight Center honored the late William W. L. Taylor with an *Excellence in Outreach in Science* Award for his accomplishments.

IN MEMORIAM
Kathleen Franzen, President 2005 - 2010
Jack Reed, INSPIRE Board Member 1992 - 2009
Jim Ericson, INSPIRE 1st Vice President 1981 - 2006

MISSION
The INSPIRE Project Inc. is a non-profit scientific, educational corporation whose objective is to bring the excitement of observing natural and manmade radio waves in the audio region to high school students. Underlying this objective is the conviction that science and technology are the underpinnings of our modern society, and that only with an understanding of science and technology can people make correct decisions in their lives, public, professional, and private. Stimulating students to learn and understand science and technology is key to them fulfilling their potential in the best interests of our society. INSPIRE also is an innovative, unique opportunity for students to actively gather data that might be used in a basic research project.

— William W. L. Taylor and William E. Pine, Co-Founders

In 2006, The INSPIRE Project's mission was expanded to develop new partnerships with multiple science projects. Links to magnetospheric physics, astronomy, meteorology, and other physical sciences are continually being explored.

From the Editor/Program Manager

Eva Kloostra

Eva Kloostra at INSPIRE's 2019 Space Academy

As a follow-up from the last volume of *The INSPIRE Journal* that featured 2017 total solar eclipse research conducted by Austin Peay State University faculty and students, NASA Marshall Space Flight Center's (MSFC) employees and volunteers, and INSPIRE Space Academy alumni students and volunteers, INSPIRE would like to congratulate the MSFC Solar Eclipse Science Team for receiving a NASA Group Achievement Honor Award. Our team leader, solar scientist Mitzi Adams of NASA MSFC, was presented the award on August 22, 2018. A special thanks to Mitzi and her colleague Dennis Gallagher for inviting INSPIRE to be part of the amazing research team. In this issue Mitzi's friend, "solar eclipse chaser" Gordon Telepun, shares his remarkable 2019 total solar eclipse photos taken in Argentina *(page 5)*.

Mitzi Adams (center) receiving NASA Group Achievement Honor Award at Marshall Space Flight Center in Huntsville, Alabama

The INSPIRE Project is celebrating its 30th anniversary this year. Co-founders Bill Taylor and Bill Pine's vision of engaging youth in Science, Technology, Engineering and Mathematics (STEM) disciplines by "bringing the excitement of observing natural and manmade radio waves in the audio region to students" is still thriving. To date over 3,600 INSPIRE Very Low Frequency (VLF) radio receiver kits have provided students worldwide a hands-on opportunity to experience the sounds of space firsthand. INSPIRE's VLF-3 kit continues to be incorporated in middle/high school science curricula and university programs both nationally and internationally. In November 2018, INSPIRE partnered with NASA Goddard Space Flight Center and Howard University in Washington, DC to sponsor a STEM workshop which included an overview of the VLF kit. Approximately 45 undergraduate and graduate students participated.

2019 INSPIRE Academy for Educators and Student scholarship recipients in their astronaut flight suits at the U.S. Space & Rocket Center in July during International Space Academy

INSPIRE Board President Dr. Phillip Webb pictured with NASA Goddard Space Flight Center's Cryogenics and Fluids Branch Head Dr. Erik Silk and Brittany Whetzel from the NASA Office of Education at Howard University on November 7, 2018

In 2009, INSPIRE expanded its STEM programs to include scholarships for middle/high school educators and students to participate in the U.S. Space & Rocket Center's Space Academy programs in Huntsville, Alabama; the Dr. William W.L. "Bill" Taylor Memorial STEM Scholarship for college/university students in Washington, DC; and internships at NASA Goddard Space Flight Center for undergraduate and graduate students. Over the past decade, INSPIRE has awarded 162 STEM scholarships and internships. Personally, when I get a phone call, letter, card, email or text from one of these past student recipients sharing with me that he or she "won a national rocketry competition and is heading to the international competition in Poland", "got accepted into a NASA summer program", "received a full scholarship to attend

From the Editor/Program Manager *continued*

Space Academy alumni STEM teacher Frank Matthews (top row) with his students and their engineering challenge projects at Kramer Middle School in Washington, DC

college", "is becoming a pilot at West Point", "is graduating from college tomorrow and I landed my dream job and want to thank INSPIRE for helping me on my journey", and the list goes on – there is simply nothing more rewarding than to have the privilege of being part of so many bright futures. A sincere thank you to our INSPIRE program sponsors, partners, friends and volunteers who are truly changing lives and helping to create our next generation of scientists and explorers. Without your support, none of this would be possible. In this issue, two of INSPIRE's past recipients tell their success stories. Charis Houston explains how attending one week at Space Academy when she was a middle school student changed her career path *(page 16)*; and past Bill Taylor Scholarship recipient Kuishon Brown discusses how INSPIRE helped him to secure an engineering position at Boeing *(page 19).*

INSPIRE Space Camp for Educators program is propelling STEM disciplines in middle and high schools throughout Washington, DC. In INSPIRE's 2018-19 annual teacher survey, 100% of Space Academy for Educators scholarship recipients reported that they are utilizing materials and knowledge acquired via the program in their classrooms – directly impacting 2,800 students in 32 area schools. Past teacher recipients have received numerous national and local awards, become principals of his/her school, and one of our teachers is now the STEM Instructional Leader for a major county school district.

Finally, fifty years ago on July 20, 1969, Apollo 11 safely landed on the moon. Though I was only six years-old, I vividly remember this historic event. INSPIRE is joining NASA in its year of celebrations by featuring Apollo 11 in the spring issue. I invite our readers to share your memories of Apollo 11 and the impact it had on your life. Please email your submission by November 30, 2019 to: editor@theinspireproject.org

On behalf of the Board of Directors, thank you to our friends, colleagues, volunteers and corporate partners for your continued support of The INSPIRE Project's mission of inspiring our next generation of scientists and explorers.

Eva Kloostra – Editor & Program Manager

(20 July 1969) Astronaut Edwin E. Aldrin Jr., lunar module pilot, is photographed during the Apollo 11 extravehicular activity (EVA) on the lunar surface. In the right background is the lunar module. On Aldrin's right is the Solar Wind Composition (SWC) experiment, already deployed. This photograph was taken by astronaut Neil A. Armstrong, commander, with a 70mm lunar surface camera. Photo courtesy of NASA

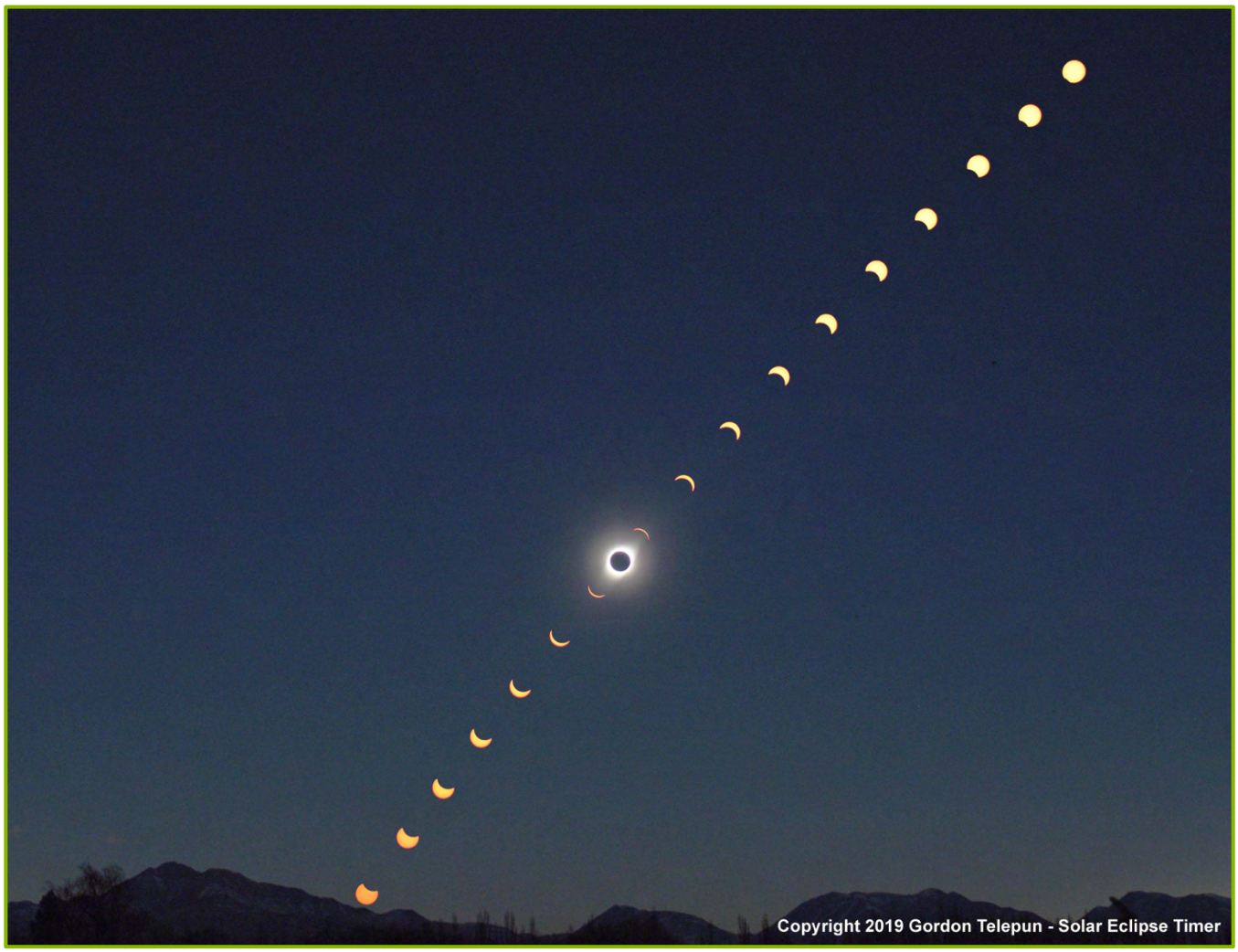
Special thanks to the following for their contribution to this volume of *The INSPIRE Journal:*

Technical Editing: Dr. Dennis Gallagher - NASA Marshall Space Flight Center, Leonard Garcia – NASA Goddard Space Flight Center and Dr. Phillip Webb – INSPIRE Board President
Graphic Design Services: Gail Breeze – Breeze Design Photography: Karin Edgett – INSPIRE Board Secretary
Printing: Image Media

And to all who submitted articles and content for inclusion

Photographer / Eclipse Timer App Developer Captures 2019 Total Solar Eclipse in Argentina

Dr. Gordon Telepun



The Natural Progression of the 2019 Total Solar Eclipse on the Ecliptic Setting into the Andes Mountains

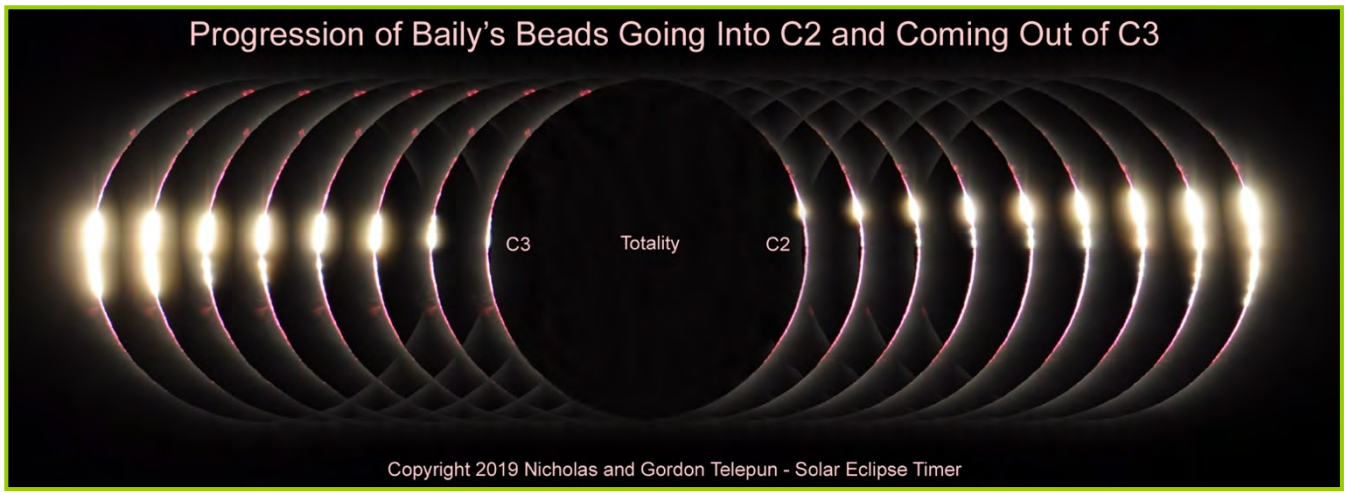
The eclipse photo sequence above was taken on July 2, 2019, in Bella Vista, Argentina (-30.43986S; -69.24750W). It is composed of 17 individual partial phase images taken with a solar filter (Seymour Solar glass) and a single totality image taken without the solar filter combined in a photo editing program. This is the natural progression of the eclipse taken with the camera and the camera tripod in a fixed position. No processing has been done other than to increase the brightness of the totality layer to show the silhouette of the mountains. The equipment was a Nikon D750 camera with a zoom lens set on 48mm creating a diagonal field of view of 48.5° which is enough to fit the sequence. The settings for the partial phases were f/4.5, 1/200s and ISO 200. The totality shutter speed was 1/50s. The time gaps between the first set of partial phase images were 7m 46s and the time gaps between the second set of partial phase images were 6m 35s. These time gaps were calculated by a feature called the Partial Phase Image Sequence Calculator in the eclipse app called Solar Eclipse Timer.

Baily's Beads Imaged During the 2019 Total Solar Eclipse

Baily's Beads is an effect named after British astronomer Francis Baily, although he may not have been the first person to describe them. They are caused by the last rim of the Sun's photosphere being seen behind the Moon as the mountains and the valleys of the limb of the Moon break up the light. Therefore, they can only be photographed without a solar filter by taking very rapid images in the last few seconds before 2nd Contact and again in the first few seconds after 3rd Contact.

Solar Eclipse Photographer Gordon Telepun *continued*

The image below is a cropped composite of the sequence. It was taken through a telescope with a camera at prime focus working at a 905mm focal length and a focal ratio of f10. The ISO was 200 and the shutter speed was 1/1000 second. The images were taken by Gordon's 14 year old son Nicholas. To view Gordon Telepun's detailed YouTube video describing the technique to image Baily's Beads visit: https://youtu.be/umdPMhTYwRs



No Sunspots But The Solar Limbs Were Beautiful

Sunspots are an eclipse photographer's friend because they help with achieving good focus, but there were no sunspots on eclipse day. It is very difficult to achieve crisp focus on the limb of the sun through a solar filter, but you can see by this image (left) that Nicholas did an excellent job. This is a highly cropped image of prominences and chromosphere just prior to 3rd contact.

Gordon Telepun and his son Nicholas

About Dr. Gordon Telepun and his Solar Eclipse Timer App

Dr. Gordon Telepun is a plastic surgeon who lives in Alabama. He is an expert eclipse photographer and eclipse educator with a special interest in the partial phase phenomena. Gordon is the developer of the mobile app Solar Eclipse Timer which is designed so he can be your personal guide and photography assistant through the stages of an eclipse. The app geolocates to calculate precise contact times of an eclipse. It does audible countdowns to the contact times and max eclipse, announces when to observe for various partial phase phenomena and automatically calculates the clock times needed to achieve a perfect eclipse sequence image.

Detailed eclipse educational videos can be found on his YouTube channel called Solar Eclipse Timer: https://www.youtube.com/channel/UCn8hUby9U97J11hg27rdSNQ

Other eclipse information, including details about the app, is available on his website: http://www.solareclipsetimer.com

INSPIRE's NASA Goddard Space Flight Center 2019 Summer Interns Report on Research Projects

INSPIRE's three 2019 summer interns with Board President Phillip Webb (left) and INSPIRE Advisor Leonard Garcia of NASA GSFC (right)

INSPIRE partnered with NASA Goddard Space Flight Center (GSFC) and the District of Columbia Space Grant Consortium to offer paid internships at Goddard. This ongoing competition is open to District of Columbia undergraduate and graduate college students. During the past ten years, INSPIRE has awarded thirty-two NASA GSFC internships. Each intern is paired with a mentor and works on a STEM research project. For more information, visit: www.TheINSPIREProject.org

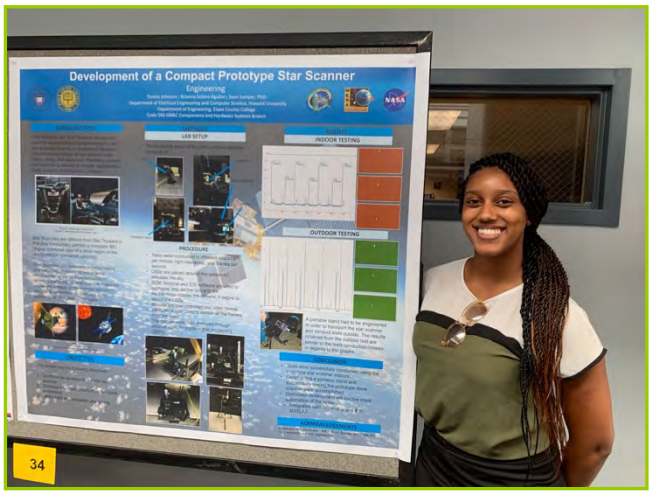
Guidance, Navigation, and Control (GN&C) Hardware and Components Analysis 2

Tramia Johnson, Howard University

I am a senior Computer Engineering major at the illustrious Howard University. Thanks to The INSPIRE Project, I had an amazing opportunity to intern at NASA Goddard Space Flight Center during the summers of 2017-2019.

Working with Sean Semper in the Guidance, Navigation & Components office to benefit his flight development efforts was an experience to remember. My partner Brianna and I worked to develop a prototype Ultra-Compact Star Scanner. A star scanner is an aid in attitude determination or planetary body scanning for navigational purposes.

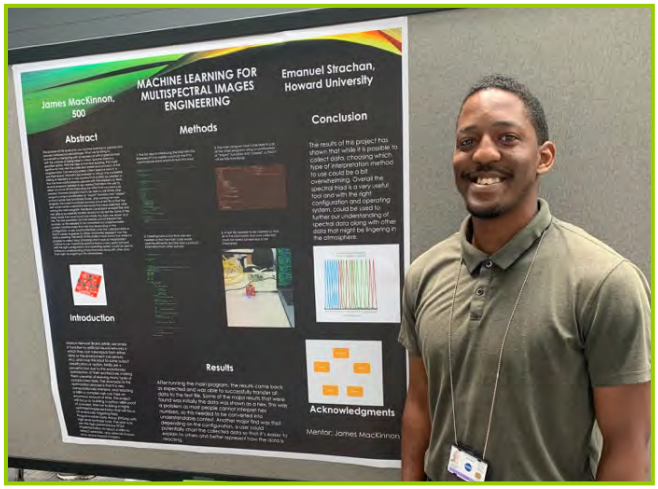
During my ten weeks, I became an expert in MATLAB and also gained experience with mechanical engineering by 3-D printing pieces for the star scanner.



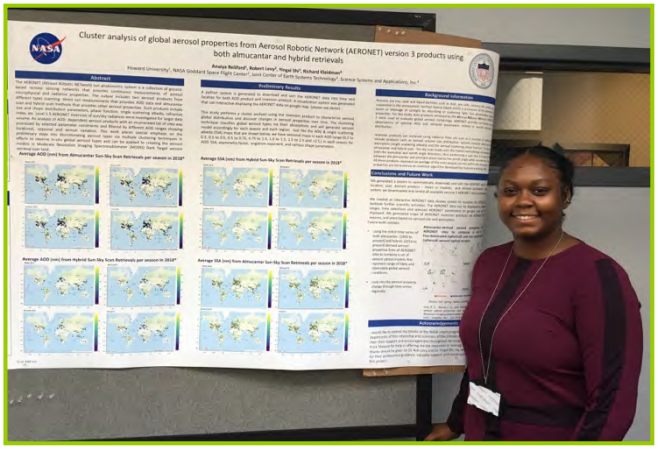
Tramia Johnson presenting her research project at NASA GSFC poster presentation on July 31, 2019

My favorite part about my time at NASA GSFC was that I was able to perform night sky testing with the scanner. I got to explore the facilities and venture outside my field to explore other career opportunities. What NASA GSFC taught me is that you should always branch out and make the most of any experience.

It has always been a dream of mine to work for NASA and become an innovator for the new world. Being able to talk to scientists and engineers that made their dreams into their reality only inspired me to work harder and be the best I aspire to be. Thank you, INSPIRE.



Emanuel Strachan (above) and Anaiya Reliford (below) at NASA GSFC intern poster presentation in July



Markov Brain Networks to Asteroid Classification Project

Emanuel Strachan, Howard University

I'm a Senior Computer Information Systems major from Miami, Florida. This summer I had the opportunity to intern at NASA Goddard Space Flight Center as a software engineer for the Markov Brain Networks to Asteroid Classification Project. The purpose of this project is to utilize the Python program language to help improve neural networks/MBN and teach them to detect asteroids and asteroid shapes from space-based imagery.

My task was to interface a Raspberry Pi computer with a spectral triad so that a user can better collect spectral data using a copious number of sensors. To complete this project, I had to create several programs that all worked together to complete a specific task. It was required that a general purpose input/output (GPIO) be created so that the triad would properly operate with the Raspberry Pi. Next, several programs needed to be created that allow the user to either turn on or off the triad using the GPIO. The main program had to be able to call all the other programs using a combination of "import" functions and "classes" so that it will be fully functional and the output is dumped into a text file so that the user could better understand the results that were collected.

During my time with NASA, I've learned a lot of programming related topics that my university does not really focus on. I learned how to better navigate and control the Linux command line, picked up on some Python skills, and I've gained a better understanding of how GPIOs operate among other things. My mentor, James MacKinnon, even took the time to teach me different coding skills to help me complete my project. NASA also held multiple workshops to help interns who might not be familiar with a certain programming language.

My time at NASA has helped me grow professionally and intellectually as well. I believe that because of my experiences, I will be better able to handle future obstacles and projects that I may encounter. I have a better understanding of the career path that I want to pursue and an insight of what to do. If I had to give advice to a potential student that wants to intern for NASA, I'd say apply and never doubt yourself because although it might seem farfetched, NASA is an agency that takes all types of majors and backgrounds. At NASA, you feel like your task is important and it is rewarding to know you are contributing to the overall mission.

Automation of Satellite and Ground Data Colocation System Project

Anaiya Reliford, Howard University

I am a 2nd year Master Candidate for a M.S in Chemical Engineering at Howard University who had the privilege of working at NASA Goddard Space Flight Center. My thesis research involves generating unmanned aerial vehicles for atmospheric sciences and my internship experience this summer allowed me to learn and understand exactly what atmospheric science is. In the summer of 2019, I developed a new, Python-based interactive display system that performs cluster analysis to characterize aerosol global distribution and discover changes in aerosol properties over time.

I obtained raw data from AErosol RObotic NETwork (AERONET), followed the inversion code to utilize the data, and wrote codes to filter and organize the data in order to build the display system. The AERONET sun photometric system is a collection of ground-based remote sensing networks that provides continuous measurements of aerosol microphysical and radiative properties. The output includes two aerosol products from different types of scanning: 1) direct sun measurements that provide Aerosol Optical Depth (AOD) data and 2) almucantar and hybrid sky scan methods that provide other aerosol properties as a function of reflectance and scattering angle. The sky scan made with the hybrid methodology simultaneously moves in both the azimuthal and zenith angle directions, thus performing a scan that is in general intermediate between the almucantar and principal plane (varies the zenith angle while maintaining a fixed azimuth); essentially, proving more data.

Anaiya Reliford at the AERONET NASA Goddard Space Flight Center Calibration Site

The clustering technique classifies global aerosol types via their absorptions and will generate aerosol models in Moderate Resolution Imaging Spectroradiometer (MODIS) Dark Target aerosol retrieval over land accordingly for each season and each region. All these products represent an average of the total aerosol column within the atmosphere including products such as aerosol volume size distribution, aerosol complex refractive index, optical absorption (single scattering albedo) and the aerosol scattering phase function.

My summer at Goddard was inspirational and I am truly appreciative of The INSPIRE Project and NASA GSFC for actualizing my ambitions. I was truly challenged and loved every single moment of it. I learned an entire new discipline – Atmospheric Science – as well as a new coding language – Python 3. My work gave me the opportunity to analyze on both a quantitative and qualitative level. I now see with broader scope of how my thesis research is advantageous from both the engineering and atmospheric science angle. I also see the endless possibilities that I have at NASA as an engineer. Thank you INSPIRE!

INSPIRE Annual NASA GSFC Intern Lunch – August 2, 2019

Pictured left to right above: Emanuel Strachan (intern), Tramia Johnson (intern), Anaiya Reliford (intern), Aaron Webb (Phillip's son), INSPIRE Board President Dr. Phillip Webb and Dr. Leonard Garcia of NASA GSFC who volunteers as a Space Physics and Intern Advisor for INSPIRE

The INSPIRE Project hosts an annual lunch for our NASA Goddard Space Flight Center summer interns to meet, network, and discuss their research projects and experiences at NASA.

INSPIRE would like to thank NASA GSFC and the District of Columbia Space Grant Consortium for their continued support of this program; the NASA GSFC Education Office for the facilitation of the internship awards; and the dedicated mentors for their inspiration and guidance.

Special thanks to Dr. Leonard Garcia for his assistance with INSPIRE's NASA GSFC Internship Program each summer.

The INSPIRE Project's William W.L. "Bill" Taylor Memorial Scholarship 2018-19 Recipient

Jamal Gilmore

Jamal Gilmore with his research mentor Ndoye Muhamad in Senegal, Africa during the summer of 2018

Every semester has been a leap of faith since the loss of my academic scholarship. Less than a quarter of a point shy of the GPA requirement, my scholarship was forfeited after my freshman year at Howard University (HU). With no source of income or parental aid, I was left with no choice but to discontinue attendance at HU for the following Fall semester. I was determined to return to HU despite this loss of financial support; as a result, I attended classes at a community college in Chicago and acquired my first job to support my return in the following Spring semester. Each semester since my return has called for a new challenging way to extinguish a $14,000 balance.

Receiving the William Taylor Memorial Scholarship enabled me to register for classes for Fall 2018. This opened the door for a subsequent scholarship that helped to extinguish my balance for the Fall. The summation of the scholarships and financial aid allowed for me to finish the semester with less stress and spend winter break preparing for Spring semester. This was significant to me because the previous years left me feeling more than drained halfway through the school year, having exhausted my resources and little to no time to prepare for the next semester.

The 2018-19 school year, as a result of the scholarship, was successful. In the Fall, I secured a position to continue research abroad with Howard University during the summer of 2019 in Puebla, Mexico (last summer my research was in Senegal, Africa). In Puebla, I did research on 2D and 3D heat transfer models using COMSOL Multiphysics software. The scholarship coupled with summer research enabled me to improve my GPA because I did not need to focus on my financial standing. I also had a successful first year as President of Sigma Phi Delta Fraternity. Since founding the first Washington, DC chapter of the engineering fraternity at Howard University in May 2018, we have had numerous events with well-known and newly flourishing companies and organizations, including NASA Goddard Space Flight Center. Furthermore, we have given back to the community and campus through community service and tutoring.

None of my experiences this school year would have been possible if it were not for the William Taylor Memorial Scholarship, and for this I am immensely grateful to be a recipient of the award.

To learn more about the William W.L. "Bill" Taylor Memorial Scholarship or to apply online, visit: www.TheINSPIREProject.org (College/University Scholarships)

About Jamal Gilmore

Jamal Gilmore is a rising Senior chemical engineering major from Chicago, Illinois attending Howard University. His hobbies include singing and songwriting, performing (theatrical), traveling and spending time with his family.

Jamal's accomplishments include: W. L. Gore Technical Intern 2019, DC Sustainable Energy & Utility Workforce Program Intern 2018, GEAR-UP program participant 2018, LEGO/SeaPerch Camp Counselor 2017, HU research mentee 2016-19, American Institute for Chemical Engineers Member, and Howard University Sigma Phi Delta Fraternity Charter Founder and President.

Jamal aspires to change the world through chemical engineering. He hopes to one day develop a global hazardous waste remediation company. Jamal uses the quotes, "Be the change you want to see in the world", "It is easier to build strong children than to repair broken men", and "The time is always now" as motivation to capitalize on every opportunity to promote positive change and humanitarianism.

It is due to his belief in leading by example that Jamal seeks to accomplish his ultimate goal of giving back to his hometown with the resources gained by following his dreams.

Visit TheINSPIREProject.org for Complete Program Information

INSPIRE Educational STEM Programs

College / University Scholarships

Dr. William W.L. "Bill" Taylor Memorial STEM Scholarship

Scholarship Awards: Up to $4,000 per recipient
Application Deadline: Ongoing

In honor of INSPIRE's co-founder Dr. Bill Taylor, The INSPIRE Project with its partners at the District of Columbia Space Grant Consortium and other science and technology organizations established this STEM (Science, Technology, Engineering, Mathematics) scholarship to help ensure our next generation of scientists and explorers. Undergraduate/graduate and high school seniors who are majoring in a STEM discipline and are currently or will be attending a Washington, DC college or university are encouraged to apply. *Apply Online at www.TheINSPIREProject.org (College/University Scholarships*)

Eligibility Requirements

All applicants must meet the following requirements and submit the required documents as outlined below:

- U.S. citizenship
- Be registered as a full-time student in good standing at a Washington, DC college or university
- Must be majoring in a STEM (Science, Technology, Engineering, Mathematics) discipline
- Submit current transcript
- Submit two letters of recommendation with at least one from a teacher or faculty member
- Submit a 300 to 500 word essay discussing how this scholarship award will help you advance in STEM disciplines and the positive impact it will have on your future career plans

INSPIRE's co-founders Dr. Bill Taylor (right) and Bill Pine (left)

College / University Internships

NASA Goddard Space Flight Center Summer Internship Program

Internship Awards: $7,300 Undergraduate Students / $9,000 Graduate Students
Internship Session: Early June - Early August (10 weeks, full-time)
Application Period: November - February *(see NASA website for dates)*
(Fall and Spring semester internships also available)

NASA Goddard Space Flight Center aerial photo courtesy of NASA

With support from the District of Columbia Space Grant Consortium and other partners, The INSPIRE Project offers paid full-time summer internships at NASA Goddard Space Flight Center.

Internship Description

NASA summer internships are educational hands-on opportunities that provide unique NASA-related research and operational experiences for undergraduate and graduate students. The internships integrate participants with career professionals emphasizing mentor-directed, degree-related, real-work task completion.

During the 10-week summer internship, participants engage in scientific or engineering research, development, and operations activities. Through these internships, participants

NASA Goddard Space Flight Center Summer Internship Program *continued*

engage in scientific or engineering research development, and participants leverage NASA's unique mission activities and mentorship to enhance and increase their professional capabilities and clarify their long-term career goals. Upon completion of internships, recipients are required to submit an article on his or her research project for inclusion in *The INSPIRE Journal*.

Eligibility Requirements

- U.S. citizenship
- Minimum 3.0 GPA on a 4.0 grading scale
- Applicants must be enrolled full-time in a degree-granting course of study appropriate to NASA's long-term professional workforce needs
- INSPIRE summer internship applicants must be undergraduate or graduate students enrolled at a Washington, DC college or university

Applicants must complete the required NASA internship application which includes a letter of recommendation and current college/university transcript

For more information and to apply, visit the NASA internship website:
https://intern.nasa.gov/
Note: After completing online NASA internship application, please email: info@theINSPIREproject.org, so that INSPIRE can confirm the receipt of your application with NASAGSFC.

Middle & High School STEM Educators
Kathleen Franzen Memorial Space Academy for Educators Scholarship Program

Full Scholarships for Weeklong Summer STEM Program at the U.S. Space & Rocket Center in Huntsville, Alabama

The INSPIRE Project teamed up with the U.S. Space & Rocket Center, District of Columbia Space Grant Consortium, Washington Space Business Roundtable and other partners to offer Washington, DC middle and high school teachers and administrators full scholarships to attend Space Academy for Educators in Huntsville.

The weeklong program during the summer includes authentic astronaut training simulators and activities developed to promote learning in a classroom setting. Curriculum includes NASA content and is correlated to the Next Generation Science Standards (NGSS). Trainees in Space Academy for Educators can earn 45 professional development hours and educators get access to a shared website with lesson plans, networking opportunities, and tips to adapt many of the workshop activities to individual class environments.

Workshop topics/activities include:

- Engineering Design Challenges
- Rocket Construction
- Math Workshops
- Living and Working in Space
- Orion Spacecraft
- Space History
- Mars & the Moon

Teachers participate in Low Earth Orbit (LEO) and Mars Missions, simulate walking on the moon and working in the frictionless environment of space on astronaut simulators and weather permitting, spend an afternoon at Aviation Challenge simulating parachute landings and helicopter rescues in the water.

Space Academy for Educators full scholarships include:

- Round-trip airfare from the Washington, DC metro area to Huntsville, AL
- Six nights lodging and meals
- Program materials, flight suit, T-shirt and USSRC exhibit ticket
- Transportation to/from the airport in Huntsville

Apply Online at www.TheINSPIREProject.org
(Space Academy for Educators Scholarships)

INSPIRE's late president Kathleen Franzen founded the Space Academy for Educators and Students programs. She is pictured with her husband, INSPIRE's late co-founder Dr. William Taylor.

Middle & High School Students

Kathleen Franzen Memorial Space Academy for Students Scholarship Program

Full Scholarship for Weeklong Summer STEM Program for Washington, DC Area Middle School & High School Students at the U.S. Space & Rocket Center in Huntsville, Alabama

The INSPIRE Project has teamed up with the U.S. Space & Rocket Center, Washington Space Business Roundtable and other sponsors to offer full scholarships to Space Academy in Huntsville, Alabama for Washington, DC area high school and middle school students.

Space Academy is an action packed 6-day program for students world-wide to participate in classroom, laboratory and training focused on space science and space exploration. Space Academy encourages teamwork, problem solving, communication skills and self-confidence. Students take part in astronaut-style training and simulations, as well as STEM activities to ensure our next generations of space science and technology explorers!

- Tumble and spin in the Multi-Axis Trainer
- Float on air in the 5-Degrees of Freedom Chair
- Walk like Apollo astronauts in the 1/6 Gravity Chair
- Experience a world without friction in the MMU
- Challenge yourself and support your Team at Area 51
- Pilots/Commanders land the Space Shuttle
- Mission Specialists walk "in space" on an EVA (Extra Vehicular Activity) to repair the Hubble Space Telescope
- Live and work in space operating the ISS life support
- Perform scientific experiments on soil samples from Mars

Space Academy for Students full scholarships include:

- Round-trip airfare from Washington, DC to Huntsville, Alabama *(INSPIRE chaperone accompanies students)*
- 5 Nights lodging and meals at the U.S. Space & Rocket Center
- Program materials, flight suit, team patch, T-shirt and photos
- Transportation to/from the airport in Huntsville

Apply Online at www.TheINSPIREProject.org (Space Academy for Students Scholarships)

Special Thanks to The INSPIRE Project's Program Sponsors, Supporters and Volunteers

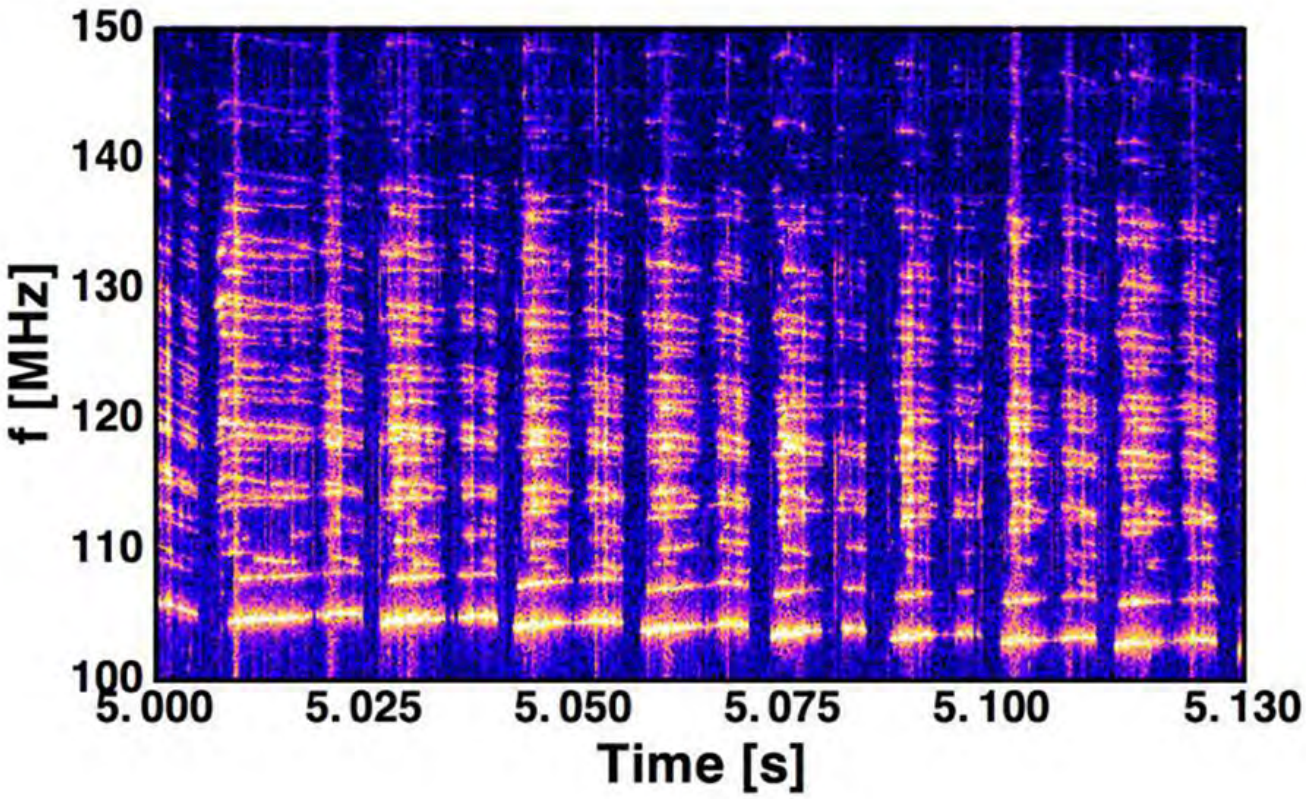
NASA | District of Columbia Space Grant Consortium | Washington Space Business Roundtable
U.S. Space & Rocket Center | International Launch Services | Space Ad Agency | Fisher Space Pen

Whistling While You Work: Fusion Scientists Find Inspiration in Earth's Ionosphere

Electromagnetic whistler waves measured for the first time at DIII-D National Fusion Facility

Courtesy of General Atomics

The challenge of fusion energy is often compared to capturing – and holding – lightning in a bottle. The analogy is apt because lightning and a fusion energy plasma have a lot in common, including very high temperatures, massive electric charges and complex fluid dynamics



Electromagnetic waves known as "whistlers", long seen in lightning and other natural phenomena, were observed for the first time in the DIII-D tokamak operated by General Atomics. Researchers believe these waves could help control damaging runaway electrons during fusion operation.

Researchers at the DIII-D National Fusion Facility in San Diego recently found another characteristic shared between the two types of plasmas: an odd electromagnetic wave known as a whistler. If their theories are correct, the whistler observation could help better understand runaway electrons in tokamaks and could even help control these destructive particles.

For more than a century, mysterious electromagnetic waves that occur naturally in the Earth's ionosphere – generally caused by lightning – have been detected over telephone lines, antennas and satellites. They were named "whistlers" because of their characteristic time-varying frequencies, which are unmistakable when the signals are converted into sound.

Theorists have for years predicted that whistlers could exist in a tokamak – a toroidal vacuum chamber in which plasmas are heated to 100 million degrees to cause fusion – but experimentalists were never able to directly observe the waves. Recently, however, a team at DIII-D was able to generate extremely diffuse plasmas with a low magnetic field that yielded the characteristic whistling of the electromagnetic oscillations. The researchers determined that the whistlers are driven by runaway electrons in the tokamak and that they play a role in regulating runaway generation and evolution.

“The whistler measurements were interesting from a fundamental science standpoint, because they improve our understanding of how runaway electrons behave in our experiments,” said Carlos Paz-Soldan, a DIII-D researcher and member of the team. “We are very motivated to see how we can excite these waves to improve runaway electron control in tokamak fusion reactors.”

Runaway electrons develop due to an unusual feature of plasmas – a collisional drag that decreases with increasing velocity. This allows energetic electrons that are in the presence of an electric field in a tokamak to freely accelerate to high energies. Runaway electrons in fusion reactors only reach a terminal velocity as they approach the speed of light, per Einstein’s theory of relativity.

Runaway electrons are a significant concern for future large tokamak devices, such as ITER, and must be mitigated due to their potential to cause significant wall damage. Multiple approaches for controlling runaways are being explored at DIII-D and other fusion facilities.

Runaway electron-driven whistler instabilities and the wave-induced scattering observed at DIII-D demonstrate that the evolution of runaway electrons may involve more than just classical collisional and radiative processes. This is an important mechanism to include in predictions of runaway generation. It also raises the possibility that externally driven waves in the whistler frequency range could be used to suppress and control runaways. The team intends to pursue this concept by installing a high-frequency helicon antenna at DIII-D to stimulate whistler waves. While much work remains to be done, the team thinks there is a possibility that exciting whistlers or similar waves in the plasma could prevent or control runaway electrons by bleeding energy from the particles.

The study titled, “First Direct Observation of Runaway-Electron-Driven Whistler Waves in Tokamaks,” included coauthors Don Spong and Cornwall Lau of Oak Ridge National Laboratory; General Atomics’ Paz-Soldan; and William Heidbrink with the University of California, Irvine, and others.

The research was featured in a study published in *Physical Review Letters*. To read visit:
https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.120.155002

For more information contact:
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About General Atomics

General Atomics (GA) pioneers advanced technologies with world-changing potential. GA has been at the cutting edge of energy innovation since the dawn of the atomic age – for more than 60 years. With scientists and engineers continually advancing the frontier of scientific discovery, GA is serving our growing planet’s needs through safe, sustainable, and economical solutions across a comprehensive array of key energy technologies.

Special Thanks to Cami Collins

Cami Collins is an INSPIRE VLF contributor who initially shared this research with the INSPIRE Team. Cami is a scientist researching fusion energy at the DIII-D National Fusion Facility in San Diego, California where she specializes in energetic particle physics and plasma spectroscopy measurements. She received her PhD from the University of Wisconsin Madison, where she built a laboratory astrophysics experiment to study accretion. She loves dogs, coral reef aquariums, and is active in STEM outreach events.

Cami Collins pictured with her INSPIRE VLF-3 receiver in her backyard

I setup my INSPIRE VLF-3 radio receiver on the hill behind my house and ran an audio cable down to a speaker on the patio so that I can relax and listen for whistler waves! The receiver is connected to an 8 ft whip antenna (part #s MFJ-1974, MFJ-7710, and a UHF SO239 Female to BNC Male cable). The antenna is taped to a wooden broomstick handle and held upright with an old metal fishing pole holder that I made in high school, and the receiver ground cable is screwed into the fishing pole holder. The signal sounds surprisingly good, I guess because the power lines are underground in my neighborhood. One problem though: a mysterious animal keeps chewing through my audio cable (coyote, maybe?)!

INSPIRE 2015 Space Academy Alumni Student Entering College in the Fall as an Astronautical Engineering Major

Charis Houston

Charis Houston at the World Space Modeling Championships in Poland last summer. Photo courtesy of Kara Kelly.

Back in the summer of 2015, I had the awesome opportunity to attend the Space Academy in Huntsville, Alabama. The opportunity was provided by the Washington Space Business Roundtable and The INSPIRE Project from a Patriots Technology Solar Competition I won along with two teammates. It was the week at Space Camp that I realized I wanted to become an Astronautical Engineer. There, I attended workshops and learned more about rockets and the Space Shuttle program that expanded human exploration/discovery of space. Prior to attending Space Academy, I wanted to become a mechanical engineer. I did not realize that my love for space and astronomy could be translated into an engineering dream job!

Having a newfound interest in rocketry, shortly after returning home from Space Academy, I joined the Team America Rocketry Challenge (TARC) competition to learn more about rockets and possible applications of it after high school. Every year, teams across the US must successfully design and build a rocket model that can meet the criteria the judges are looking for. Each year the criteria changes, so there is no way of repeating the same design over and over. You learn to be strategic and creative to solve many problems that arise. My TARC mentor introduced me to competitive Space Modeling, which is designing, building and flying model rockets. After many hours of building, painting and practice flying, I was selected for the US Junior Team, which traveled to Poland the summer of 2018 to compete in the World Space Modeling Championships with junior level competitors from 24 countries. I will travel to Indiana in the summer of 2019 to compete in the qualifying rounds for the next US Junior Team which will compete in Romania the summer of 2020.

Looking back, who would have thought that one week in Huntsville the summer after my 8th grade year, would change the trajectory of my life! I am counting down to blast off on an exciting journey via college and career. In the Fall, I will be attending Capitol Technology University, majoring in Astronautical Engineering.

Thumbs up to Washington Space Business Roundtable, Patriots Technology, and The INSPIRE Project and its staff which were the fuel and boosters I needed to launch into my future!

Charis Houston at high school graduation in June 2019. Above Fellow INSPIRE Space Academy alumni Bryce Stephens and Charis Houston at the Aviation Week Awards Dinner with Astronaut Peggy Whitson and John Langford, CEO Aurora Flight Sciences, held in Washington, DC in March 2018.

Why I am a Volunteer for The INSPIRE Project

Karin Edgett, Board Secretary

Alchemy. When you experience young people's minds, eyes and hearts open and expand, change happens. Each kid that I have had the honor to chaperone through Space Camp has shifted meaningfully. They are never the same person, in as little as one week. It's true alchemy.

For example, Colby, an extremely reserved 13-year-old who would not take off her sunglasses, was able to return to experience the next level of Space Camp this summer. Just 3 years later, you would not believe the extroverted star she is – immersing herself in every project and engaging enthusiastically in every mission with her teammates. You can see this in the photos below of Colby.

Karin exiting the Discovery Mission simulator after taking photos of students during Space Academy in July 2019

The ways I volunteer for INSPIRE include; chaperone and photographer for the Space Camp attendees from Washington, DC to Huntsville, Alabama and back, local liaison, events photographer, Solar Competition judge, and I serve as Board Secretary.

My most arduous and fun volunteer experience to date was as chaperone/escort/photographer for 17 Space Camp Alumni from Washington, DC in July 2017 to Austin Peay State University (APSU) to work with NASA and APSU on Total Solar Eclipse research. About 12 of us ran experiments with NASA scientist Dennis Gallagher in a remote Kentucky soybean field that included photographs, 360º videos recording atmospheric changes, butterfly behavior observations and measuring VLF sound waves with The INSPIRE Project's VLF receiver (Eva was with another crew with NASA at the APSU University Farm running experiments). To clarify, I said arduous, since our flights were cancelled and we had to quickly commandeer a large bus, two drivers and drive all night to get to Clarksville, Tennessee as an eclipse waits for no one.

The INSPIRE Project is a fabulous organization that exposes young people to STEM through real-life and very creative experiences laying seeds for unforeseen possibilities. INSPIRE's close ties with NASA provide the much-needed hands-on exposure to mathematics and sciences like chemistry, astrophysics, biology, etc., and also exposure to team-building and physical endurance.

The INSPIRE Project has stayed true to its mission to reach the underserved communities of Washington, DC and expand young minds.

Our programs that depend on financial support include:

- Scholarships to space academy for middle/high school teachers and students (including all travel expenses, flight suit, etc.) $2000 each
- STEM scholarships for college students $4000 each
- NASA summer internships $7000 each
- VLF Kits (we sell these kits around the world at no profit) $120 each, plus shipping

(Right) Karin Edgett with INSPIRE's 2018 Space Academy for Educators scholarship recipients following their graduation at the U.S. Space & Rocket

Why I am a Volunteer for The INSPIRE Project *continued*

We are currently in need of volunteers to provide the following support to
our organization:

- Social Media Guru
- Assistance with Setting Up New Website
- Researching/Identifying STEM Grant Opportunities
- Researching/Corporate Giving Opportunities
- Relationship Management with INSPIRE Alumni
- INSPIRE VLF Kit Technical Advisors
- Distributing Program Materials to Washington, DC Schools & Universities
- General Administrative Assistance
- Public Relations Outreach
- Event Photography

Karin conducting research at a soybean farm during the 2017 Total Solar Eclipse in Guthrie, Kentucky

Karin volunteering as a judge for the 8th Annual Solar Competition held in Greenbelt, Maryland during Spring 2019 – the winning team accompanies INSPIRE to Space Academy

Currently we serve about 3,000 young people in the underserved DC Metropolitan area each year and have shipped over 3,500 VLF Kits worldwide. If you would like to support our effort by volunteering, or sending a kid to Space Camp, or making a scholarship donation, etc. we would love to hear from you. Please contact Eva at: info@theinspireproject.org or call 727.641.3468.

I met The INSPIRE Project though its founders, Bill and Kathleen, 25 or so years ago. They were friends of mine, and Kathleen and I were fellow small business owners on Capitol Hill while Bill was off working at NASA. I had an advertising agency at the time and helped create a logo/brand/website and other materials for INSPIRE. I was hooked from day one on the whole idea of listening to tweaks and spherics and other unsuspecting sounds in our atmosphere.

Over the years, I have had many friends at NASA and have collaborated on numerous projects including a NASA award-winning wrist band that keeps track of UVA+B (sun) exposure.

There has never been a time in my life where I wasn't creating and volunteering. I met Kathleen while volunteering at the local small business and community association. Two of my most impactful opportunities to volunteer were as a foster parent for teenage girls in Washington, DC and working with teenagers with The INSPIRE Project.

I have always chosen to volunteer at organizations where I can see the impact in the community first-hand.

About Karin Edgett

Karin is "a creator and facilitator with the goal of opening hearts and minds." She is now primarily a nutritional cook and artist. Her art explores the not-yet-known through abstract and conceptual paintings. She is currently working on a series of infinity patterns that "reflect the interconnectivity of all of humanity, of every living being, of all light and energy."

To view Karin's work and upcoming art shows visit: https://www.karinedgett.art

INSPIRE's William Taylor Memorial Scholarship Past Recipient Launches Career at Boeing

Kuishon A. Brown

The Dr. William W.L. "Bill" Taylor Memorial Science Scholarship has been a blessing in my academic career not only once, but twice. Being a former recipient in the years of 2017 and 2018 consecutively, provided me the monetary funding needed to complete my college education. I have had many setbacks on the journey to obtain my B.S. in Mechanical Engineering not including an extra academic year at Howard University (HU). Subsequently losing my scholarship following the close of my freshman year, I nearly lost hope on continuing my tenure at HU. Yet everything changed the moment I sought scholarship opportunities from great programs like The INSPIRE Project. I have a never give-up mentality, and a great take on past failures setting the stage for future successes. By applying to the scholarship as an applicant and reaching out to the helpful and informative Ms. Eva Kloostra, I was given a chance to change the narrative of my academic life.

Kuishon Brown (right) at the AAIA Aerospace Spotlight Awards Gala in Washington DC in May 2019

With a combination of a few other external scholarships, grants, and personal out-of-pocket expenditures, I met my financial needs and cost of attendance at the university. Looking back on it now, I was able to lessen my hours at my part-time job(s), whilst gaining valuable time to review and commit to my studies. All due in part to the opportunity the scholarship gave me, and the rewarding feeling of knowing I'd be able to pursue my dreams with peace of mind financially. While pursuing my degree, I was fortunate to work part-time during the last two school years as a Systems Engineering Intern at Boeing. This foothold in the industry helped me further develop as an early career professional and secured me a full-time opportunity with the company. I now stand proudly as a recent graduate and Systems Engineer at The Boeing Company within their BDS (Boeing Defense, Space and Security) division.

Many will see the end result, but never truly understand the building blocks and sacrifice necessary to make it to that end goal. I am fortunate that after four years of constant ups and downs, I get to share this story. Most of all, I am driven by the notion to pay it forward to the next generation of scholars — similar to me — who only seek a push in the right direction and for the right investment in their education. The payout is bigger than the initial investment and I seek to do my part in being a part of someone else's academic and professional journey; the same way The INSPIRE Project has been in my life. The Dr. William W.L. "Bill" Taylor Memorial Scholarship is not just an esteemed award to be received, but a gateway to academic and professional success.

To learn more about the Bill Taylor Memorial Scholarship, visit: www.TheINSPIREProject.org (College/University Scholarships)

About Kuishon Brown

Kuishon Brown graduated in May 2019 at Howard University in Washington, DC with a BS in Mechanical Engineering. Kuishon was born in Massachusetts and moved to Brooklyn, New York where his parents reside. He enjoys stepping, playing the cello, reading, basketball, public speaking and networking.

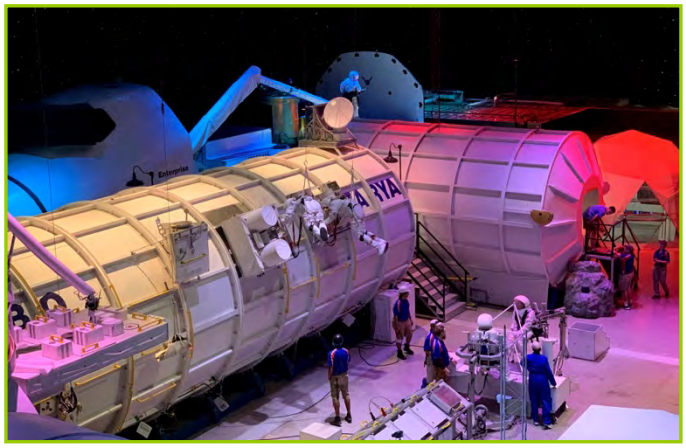
Kuishon's academic accomplishments include: 2014 BAI scholarship recipient, School Technology Summit 2015 - Welcoming Speaker, NSBE NLI Participant/Mentee 2015-2016, JP Morgan Launching Leaders Program 2016, The IMPACT Movement FRC 2015 and 2016, and a member of the HU Boeing Team 2015-2016.

Kuishon began his career at Boeing in June 2019 as a Systems Engineer.

He is a firm believer of "treating the whole by each part" and strives to work with other outstanding peers. He stands by the mantra "to become a better person today, than the man I was yesterday" and strives daily to follow and build upon this objective.

Kathleen Franzen Memorial Space Academy Scholarship Program

Space Academy – Inspiring Our Next Generation of Scientists and Explorers



During the past eleven years, thirty-nine educators and seventy students have been awarded full scholarships to participate in this educational STEM program. Special thanks to INSPIRE's sponsors including the Washington Space Business Roundtable, District of Columbia Space Grant Consortium, Patriots Technology Training Center and private donors for their support and inspiring our next generation of space scientists and explorers.

INSPIRE's Kathleen Franzen Memorial Space Academy Scholarship Program is week-long educational program for middle and high school educators and students held at U.S. Space & Rocket Center (USSRC), NASA's official Visitor Information Center for Marshall Space Flight Center, in Huntsville, Alabama. INSPIRE's recipients participate in International Space Academy each July so teachers and students can engage with others from around the world.

Space Academy promotes science, technology, engineering and mathematics (STEM) through hands-on activities and missions based on teamwork, leadership and decision-making. The action-packed week includes 50+ hands-on STEM activities and experiments. Aside from astronaut training, the Space Academy for Educators program includes intensive classroom, laboratory and training focusing on space science and exploration activities developed to promote learning in a classroom setting. The curriculum includes NASA content and is correlated to the National Science Education Standards. This program equips teachers with knowledge, activities and materials to excite, engage and attract students to STEM disciplines.

To reinforce the Space Academy experience, INSPIRE hosts a post-graduation lunch for scholarship recipients each year in the USSRC Education Foundation's Boardroom – home to Dr. Wernher von Braun's conference table. The same table where his team designed the Saturn V rocket. Teachers and students can talk one-on-one with INSPIRE Board Member and former astronaut Rick Chappell and INSPIRE Advisors/NASA Marshall Space Flight Center scientists Mitzi Adams and Dennis Gallagher. They each generously share their knowledge, personal successes and defeats, answer endless questions, and most importantly truly excite and inspire the students and educators alike. Thank you Rick, Mitzi and Dennis for providing this life-changing experience.

Thanks to Fisher Space Pen for donating Apollo 11 Anniversary pens to INSPIRE

Anniah, 2019 recipient, demonstrating how well her Space Pen writes

INSPIRE's 2019 recipients and NASA guests pictured with model of Saturn V rocket on von Braun's table at post-graduation lunch

2018 Space Academy Educators' Report on the 2018-19 School Year

In INSPIRE's annual 2018-19 school year survey, 100% of Space Academy for Educators STEM scholarship recipients (who are still currently teaching in the Washington, DC area) utilized materials and knowledge acquired via the Space Academy program directly impacting approximately 2,800 students in 32 schools. (The 2019 teachers will be featured in the Summer 2020 Volume of the Journal.)

DeAnne Flournoy at the Homer Hickam Launch Complex preparing to launch the rocket she built. Rocket construction is one of the most popular hands-on activities that teachers incorporate in their curricula

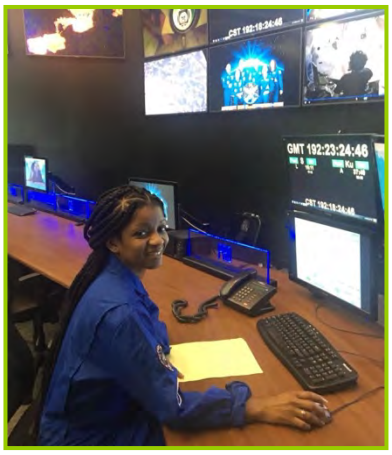
DeAnne Flournoy, Eastern High School
Space Academy for Educators in Huntsville was the best continuing STEM education experience I have ever participated in. Teachers from around the world (Italy, Japan, New Zealand, etc.) were teamed up ~ our team was Destiny ~ for astronaut training personally and professionally. While I worked harder that week than I do sometimes during the school year, it did not feel like work. We were assigned exciting tasks and learned hands-on lessons that I included in my lesson plans for students of all grades and levels. We got an in-depth background of NASA's space programs, built and launched rockets, learned fun engineering challenges that could easily be executed in the classroom and participated in Space Shuttle Missions complete with ISS science experiments, space walks, mission control, etc. in a training center with life-size models of the shuttle. In addition, we got to have one-on-one time with Homer Hickman and Ed Buckbee, and we were interviewed by NASA scientists. Besides the tremendous STEM educational experiences, one of the best parts was the team building that continues today via our Google group chats. It serves as a great resource for idea sharing and "what worked and didn't work and why not" discussions. I made life-long friends from across the planet with fellow educators which I would not trade for the world.

Jake Oster – Theodore Roosevelt High School
Space Academy was inspirational – it was fantastic! It reinvigorated my passion for exploring the unknown. By acquiring the educational curricula and implementing it in my classrooms, my students have a new interest and appreciation of space exploration and other sciences as well. Below are examples my students' accomplishments from this past school year:

- We launched a Donors Choose campaign and won eight Sphero robots to jumpstart the creation of a coding and STEM centered after school program. These robots made appearances in several classroom lessons and were used by individual students to learn coding as well!
- Students in the 9-10 grade Physical Science class spent their first few days of class exploring engineering practices and design practices by doing the egg drop experiment I learned. Students worked in teams to develop and refine a prototype that would protect an egg from a one-story fall!
- Students in the same science class then transferred those design skills in order to design a paper stomp rocket. Student designs were modeled after airplanes and rockets. Each student was given financial and weight constraints, ideas taken from the NASA design challenges. Students then tested their rockets, with the winning rocket traveling over 57 yards on the football field.
- Students then began to explore actual NASA endeavors by tuning in to several livestream launches during class and after school. Staff and team members were invited to also partake in the viewing experiences.


Jake's selfie with his fellow educator team members in July 2018


Jake and fellow INSPIRE Educator, Kalika White, at the USSRC Museum during 2018 International Space Academy



2018 Space Academy Educators' Report *continued*

Kalika White ~ Patriots Technology Training Center
My journey to Space Academy for Educators was due to coaching a team of students who won first place at the Solar System Competition held by the Patriots Technology Training Center and sponsored by the Washington Space Business Roundtable. Participating in the many activities during Space Academy allowed me to incorporate topics of space travel in the Patriots' STEM programs. This year I went from coach to Chair of the LEGO Robotics Competition, providing guidance for coaches and teams. Space travel was the theme for this year's competition. Information provided during Space Academy was shared, and team-building activities were duplicated during team practices. In addition, I became an advisor to the Solar System Competition, sharing information from space camp. This increased student interest on space travel and survival in space. Space Academy was a wonderful experience which enhanced my ability as a STEM coach and advisor.

I utilized the egg drop activity as a design challenge for the introduction to engineering design class. The motivation of dropping the egg kept the students on track as they address all design process elements. ~ Angelique Sykes, H.D. Woodson High School (pictured far left)

2018 Space Academy for Students

Cameron T. (7th Grade)
In April of 2018, my team won the Solar System Competition which was hosted by Patriots Technology Center in Maryland where I live. The competition was fun working as a group to gain information on planets in our Solar System. It also taught me many things I did not know about Mars. The prize we won was a trip to Space Camp in Alabama. Space Camp led to teaching me how to work in Mission Control and showed me how to pilot Space Shuttles and other things. At Space Camp, there are people from all over the world from places like China, Japan, Greece, Australia, etc. While we were at Space Camp we had activities during the day, things like Missions and simulators. Missions were a very hands-on experience and they had us do things that astronauts and Mission Control(MOCR) would do such as Extra Vehicular Activities (EVAs), piloting Shuttles and telling crew members what is going on outside of the Shuttle. They also had these rides called Space Shot and G-Force Accelerator. Space Shot gave you the feeling you were blasting off into outer space. Then G-Force Accelerator made you feel the G's of force you feel when you're on the Space Shuttle. The cafeteria in Space Camp was amazing they served food from different countries all around the world. The habitats that we stayed in were pretty cool. The beds were pretty comfortable. The space suits we got looked like the ones astronauts use. We also built a model rocket as a group. Later that week we launched them and they went flying up into the air and the parachute deployed. Then the next day we all rebuilt and launched them again. We did team building exercises like building a cage with PVC pipes in water. On graduation day we got to hear a speech from Miss Dottie Metcalf-Lindenburger which inspired me to want to learn more about space and our universe. This space program furthers your STEM mindset. What I enjoyed the most was doing team building exercises and bonding with other campers. Space Camp was an amazing experience and I would love to return. Thank you to Patriots and to INSPIRE for making this opportunity possible.

Cameron "walking on the moon" on the 1/6 Gravity Chair in the Astrotrek Center

My experience at Space Camp can be described as extraordinary, because there's no camp anywhere close to this. I was able to make new friends with people from other parts of the world. I enjoyed the different challenges and working as a team.
~ Kameron W. (8th Grade)

2019 Space Camp/Space Academy for Students

How Space Camp Has Propelled my Interest in STEAM

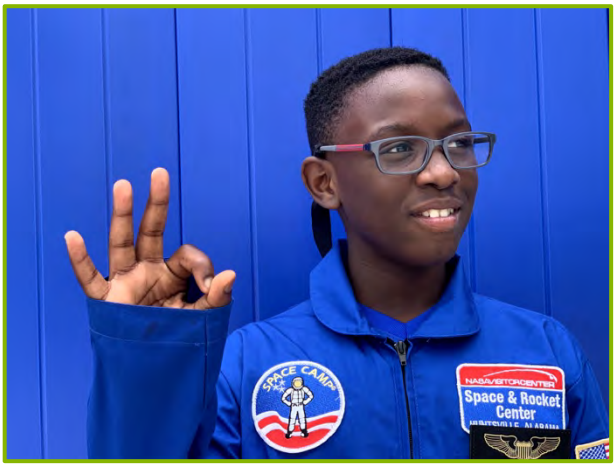
Samuel A. (7th Grade) – 2019 Space Academy, *Journey to Mars* Solar Competition Winning Team Member

Thanks to The INSPIRE Project, Patriots Technology Training Center and the Washington Space Business Roundtable, I got to go to Space Camp in Huntsville, Alabama during the second week of July 2019. I originally wanted to be an Engineer, then I wanted to be a Radiologist. When our team won the Solar System competition and got to go to Huntsville, Alabama, that's when my interest in Aeronautical Science sparked – specifically in Aeronautical Engineering.

Samuel on board the International Space Station (ISS) during his team's Orion Mission training

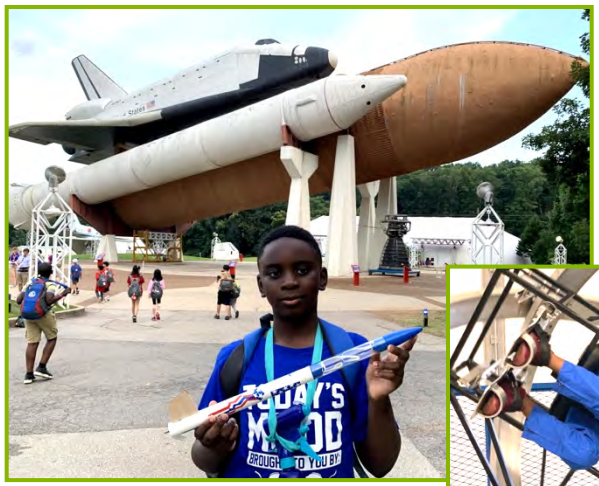
At Space Camp, we got to do multiple simulators; some were used to train astronauts while others were demonstrations of what astronauts got to do in space. These simulators captured my curiosity, and made certain questions run through my mind. One of these questions was how did they build the simulators? Another question was how can I reverse engineer this in a way that I can apply this to life on Earth, the Moon, Mars, and beyond? Basically, the simulators helped propel my interest in Aeronautical Engineering.

During my time at Space Camp, we didn't just do simulators all the time. We got to do "Missions" as well. My group was on the Orion and for our second Mission, the ISS (the experiment on the ISS got me thinking the most). "On board" the ISS, I was a scientist and we did an experiment with Bromothymol Blue, Calcium Chloride, and Sodium Polyacrylate. These propelled my interest in Aeronautical Science because when we mixed Sodium Polyacrylate with Bromothymol Blue, it turned warm and orange red; then, we mixed Calcium Chloride with Bromothymol Blue and it turned cold and dark blue. This time the question I thought of was, can I use these mixtures to cool and heat space suits? This further inspired my interest in Aeronautical Science.



Samuel in his flight suit following Space Academy Graduation

All in all, my experience at Space Camp in Huntsville, Alabama was phenomenal and a life changer. Meeting NASA's Mitzi Adams, Dennis Gallagher, and Astronaut Rick Chappell was amazing. The experiments, simulators, and teamwork were very important to me and I hope they are important to you. I also wish that The INSPIRE Project will and has inspired you. I would like to say a huge THANK YOU to Ms. Karin Edgett and Ms. Eva Kloostra.



Akin-Ayomi on the multi-axis trainer (right)

Akin-Ayomi O. (5th Grade) – 2019 Space Camp, *Journey to Mars* Solar Competition Winning Team Member

I arrived at Space Camp in Huntsville, Alabama on Monday, July 8, 2019. My flight got delayed two times and on Monday I got to Space Camp at 5pm. Then that afternoon, I met up with my team and afternoon trainer Zach and we went to dinner. Our team did a fun group activity to end the day before going to bed. The counselors did something that reminded me of school by having us line up and head to our rooms for bedtime. I met my roommates and the counselors came in and counted down from 3,2,1 then lights off. Next morning, we woke up at 6am and got ready for a full day of activities and fun. We met our morning crew trainer, Nilah, and went to breakfast. Breakfast was great and hanging out with my roommates. We had a fun morning activity, Mars Base 1. Our team completed 6 activities that day which were full of fun and energy. Our counselor Zach returned and we got to go on some rides. Later in the evening, we had dinner. After dinner we completed our last activity. Overall, we had a busy and eventful day. There were a lot of space and science activities every day, all week – moving around, exploring and adventure. I watched groups build and launch rockets. We had a Trivia Night which was really fun and different for me. I never imagined attending space camp. I had an amazing time and would love to go again next year.

2019 Space Camp/Space Academy for Students *continued*

Commander Anniah during Mission training

Anniah R. (8th Grade) – 2019 Space Academy

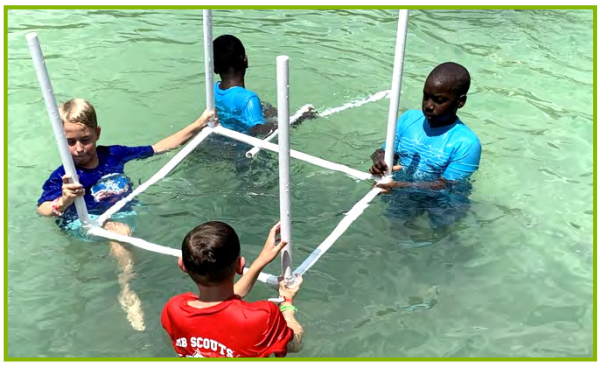
I was lucky have been awarded a scholarship with INSPIRE to attend Space Academy in Huntsville, Alabama. During my five days there, I went through life-changing experiences. At the beginning of the trip, I wasn't so sure about trying new things. This was my first time being away from home and being around new people was hard for me. Luckily, as the days went by, I made progress as I began to make friends and come out of my comfort zone. The activities I enjoyed most during my time at space camp were the multi-axis trainer, completing Missions, and the G-force ride. The multi-axis trainer was a simulator that astronauts use to train and experience the disorientation one would feel in a tumble spin during reentry into the Earth's atmosphere. While on Missions, I was the Commander and had to safely land the Space Shuttle back on Earth. The G-force ride was a ride that had no seats. When the ride goes, it spins at 45 miles per hour. The spinning causes pressure to be put on your body meaning you are being pressed on the wall. I also enjoyed meeting new people from all over the United States. When I first got to camp and met my team, I wasn't very comfortable (I arrived a day late due to our flight being cancelled). But there were four girls that were nice to me. Two of them were from Illinois, another was from Mississippi, and the last one was from Michigan. As a matter of fact, one of my friends that I made at Space Camp and I communicate with every day through social media. Five of my team members and I created our own rocket and got to launch it. Our rocket was the best one of the whole week. Unfortunately, it was so good that it landed in the "Rocket Hall of Fame" – up in the tall trees way on the other side of the road. I also appreciated my INSPIRE Commanders, Ms. Karin and Ms. Eva. Throughout my time at Space Camp, they would check up on me to make sure I was fine or see if I needed anything. Just before graduation, there was a mix-up with my astronaut flight suit. Commander Eva found out about the mistake and worked things out so that I had the correct flight suit for my graduation. This was an amazing experience that I will never forget. I definitely want to come back next year.

Anniah (right) with her winning rocket construction team-mates at the launch pad

Daniel H. (6th Grade) – 2019 Space Camp,
***Journey to Mars* Solar Competition Winning Team Member**

When I went to International Space Camp, I had a lot of fun. Lots of people from different countries and states came. In the morning and afternoon, we went to the sick bay so that if someone needed medicine, they could take it. My favorite parts were going on the multi-axis trainer, G-force accelerator, the lake activity, launching model rockets, and having lunch with the NASA scientists and an astronaut after graduation. Something that I did not like was having to sleep away from my family for the first time. Other activities that I did with my team members were going to the Intuitive Planetarium, riding on the one-sixth chair, creating a Mars base, going rock wall climbing, and visiting the Apollo 11 exhibit. I liked how the meals were based on different nationalities. After meals, we weighed our trash, food waste and liquid waste. On Thursday, Wendy Lawrence came and spoke to us about how she became an astronaut and then came again at graduation. Because it was Apollo 11's 50th Anniversary, we watched the CNN film: Apollo 11. We learned many things about space, telescopes, and rockets. After dinner, we had team activities such as Trivia Night, Scavenger Hunt, and Building Night. We learned that on the International Space Station, astronauts recycle their pee into drinking water and that the needle on Saturn V was a method of escape in case something happened during launch. We made parachutes, landers, and filters. Our crew trainers were nice. Overall, I really liked Space Camp and I would prescribe it to all children who dream of being an astronaut, an engineer, or even a pilot. If a child likes space and is fine sleeping away from home, then Space Camp is a great place.

Daniel (above) on the multi-axis astronaut trainer



Daniel (right) with his fellow team members in the lake at Area 51, participating in one of the many engineering activities at Space Camp

2019 Advanced Space Academy for Students

Colby Gray (12th Grade)

It was truly an honor to be selected to participate in Advanced Space Academy through The INSPIRE Project. As an Advanced Academy participant, I got the opportunity to take part in so many activities that are used for actual astronaut training. In the "Gravity Force" simulator, I experienced the typical amount of G's (3G's) for a rocket launch. I stayed in a confined sleeping quarters similar to that of being on a spacecraft or facility on the moon. We completed activities submerged underwater to simulate the gravity and feeling of being in space. I climbed a 30 foot pole to test my agility and balance. The multi-axis trainer imitated the experience of an out of control tumble spin. I was able to act as a Mission Operations Director where I took charge in Mission Control of keeping everybody on track; as well as getting to act as a Flight Director where I got to do experiments and handle medical anomalies on the International Space Station. I also performed an Extravehicular Activity (EVA) where I was attached to a harness, wore the space suit and made the long journey to replace a part of a satellite and back. We got to do critical thinking, creative, and teamwork challenges in our engineering teams such as creating a waterproof, heatproof, radiation-proof, and damage-proof suit for an astronaut. My team built, designed and launched our rocket that we made entirely ourselves. I also got to eat dehydrated food. Aside from the simulations and training we learned common Russian phrases in order to communicate on the ISS (International Space Station) with others. We got to debate about a future space force and other space laws. There were seminars about astrology and how to use a telescope, how we are going to be able to explore black holes and more. We learned a lot about the Apollo and Gemini Missions and even had a Space Bowl about them. By far my favorite part was getting to have lunch with NASA's Rick Chappell, Mitzi Adams and Dennis Gallagher. We got to talk about how to get into the different space-related professions, getting over fear, and giving your all into your passion. I was truly inspired and honored to talk with these individuals.

Colby and NASA MSFC Solar Scientist Mitzi Adams at INSPIRE's Space Academy Graduation Luncheon

Clark Gray (College Freshman)

I really cherish the opportunity to attend Advanced Academy during the International Space Academy program. It taught me a lot more about communication, leadership and cooperation. My sister and I were placed on Team Arcadia. On Team Arcadia, almost everyone was from different places so it was both interesting and challenging as a team. There were many students from other countries and I feel that our conversations and experiences were similar to those between scientists on the International Space Station (ISS) and will further prepare me for college as I plan to study International Relations, with a possible focus in engineering, at Syracuse University this Fall. As a part of Advanced Academy, we participated in some of the more intense trainings and simulations. I especially enjoyed scuba in the Underwater Astronaut Trainer (UAT). After graduation, INSPIRE held a lunch for us. We had the opportunity to meet a pretty cool guy and astronaut. His name is Charles Richard Chappell, but he goes by Rick. He was the Associate Director for Science at NASA's Marshall Space Flight Center in Huntsville, Alabama. Rick served as the Chief Scientist for the center advising the center director on all science and university programs while maintaining interaction with leading scientists throughout the world. He has directed research in solar terrestrial physics and has been a principal investigator on several satellite missions. He taught me a lot about life and gave me some advice that I don't plan on forgetting any time soon. We also reunited with our two favorite NASA scientists from the Total Solar Eclipse of August 2017 – Dennis Gallagher and Mitzi Adams. They shared interesting stories, as well as data coming from new plasma findings. Overall, I had a great time and am grateful for The INSPIRE Project.

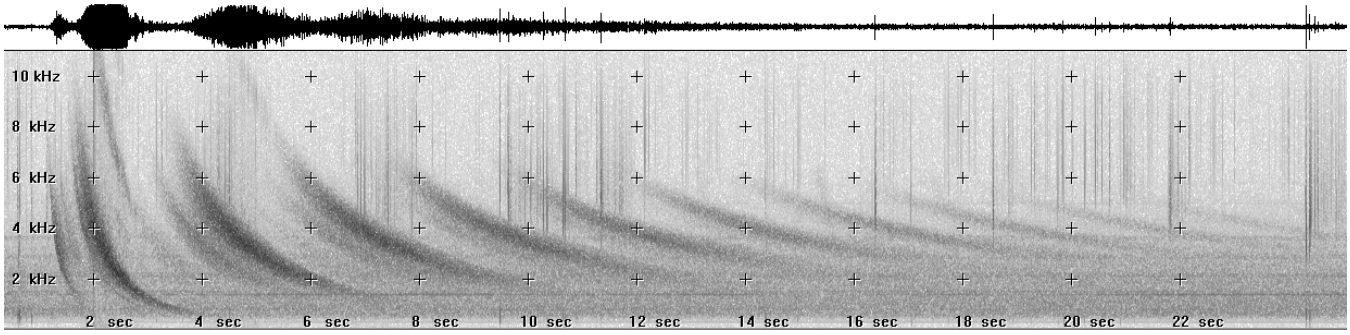
Clark with INSPIRE Board Member Rick Chappell after the graduation lunch

Yahoo VLF Discussion Group

Shawn Korgan, Founder & Group Moderator and Mark Karney, Group Administrator

The Yahoo VLF Discussion Group was founded by Shawn Korgan in 2001 for those interested in Very Low Frequency (VLF) emissions. Over the past 18 years the group has grown to over 1,700 members. The Yahoo VLF Group is an open group and anyone can join and participate in discussions. Files and photos are not accessible until a person signs in with a Yahoo account; this is a Yahoo limitation which Mark and Shawn have no control over. Older posts contain many discussions regarding the types of sounds that can be received while newer posts touch on a numerous topics, many of which have to do with setting up home based VLF receivers. Mark and Shawn attempt to keep the group professional and on topic as much as possible which has led to its popularity and success. It is their mission for the group to continue to prosper in their endeavor to explore and understand the scientific world we live in. Visit: https://groups.yahoo.com/neo/groups/VLF_Group/info

To subscribe, email: VLF_Group-subscribe@yahoogroups.com



Amazing, very loud one-hop whistler with nine echoes – Don't expect whistlers to always be subtle in nature! Image courtesy of Shawn Korgan

About Shawn Korgan

Shawn Korgan was born and raised in northern Colorado. He became interested in radio astronomy while in middle school during the 1980's in large part due to reading a magazine article advertising VLF receivers which could tune into the amazing sounds of the Northern Lights and whistling sounds generated by lightning. In the late 1990's when the Internet became available where he resides, he discovered how to construct a VLF receiver and listen to the amazing sounds of nature personally. His most active period of VLF monitoring was between 1998-2009. Shawn has always enjoyed the VLF discussion group as it allows members to work together to accomplish otherwise impossible tasks such as designing software to eliminate power line interference and setting up almost a dozen online VLF audio streams from around the world. Visit: http://www.abelian.org/vlf/

INSPIRE VLF-3 Receiver Technical Notes

Dr. Dennis Gallagher & Paul Schou
INSPIRE VLF Receiver Technical Advisors

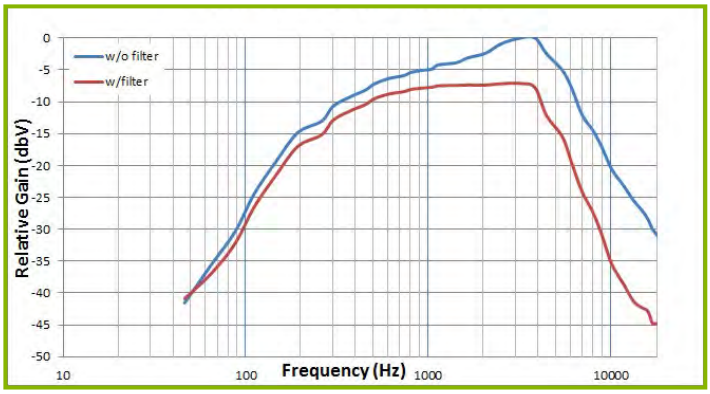
For 30 years, the INSPIRE Very Low Frequency (VLF) radio receiver kit has been designed with one underlying goal – to educate students of all ages about the sounds of space through hands-on experience. Building one's own electronic device is a step forward to opening the world of scientific exploration and showing that this complex world is made up of many simple components working together. (Did you know the VLF-3 receiver kit has 114 parts?) To date, over 3,600 INSPIRE radio receiver kits have provided students the opportunity to experience the sounds of space firsthand and the interest in VLF kits continues to increase. INSPIRE VLF receiver kits have been incorporated in pre-college and higher educational curriculums throughout the world. The receiver's features include an internal battery / external battery connection and stereo audio plugs for listening to the VLF signals between 300 Hz up to 20 kHz.

VLF Questions from INSPIRE VLF-3 Receiver Users

Below are questions submitted to INSPIRE during the past year; and our Technical Advisors' responses.

What type of antenna do you recommend using with the VLF Receiver?
Any fixed or telescoping whip antenna with an integrated BNC connection will work. There are several viable options available online. Note: A 2-meter length of sturdy wire attached to the terminal screw for the antenna will work almost as well but is slightly less easy to transport.

What is the "filter" and "data level" for on the faceplate of the INSPIRE Project kit? And how do you use them?
The "filter" switch when on passes the antenna signal through a low pass filter for the purpose of reducing strong local radio broadcasts, such in AM radio. If there is not a nearby radio station antenna, then this should be left off. "Data level" refers to the gain applied to the signal that is delivered to the "DATA" output jack. This is a microphone-level output that is suitable for connecting to a recording device but is not suitable for listening to directly using headphones. This DATA LEVEL gain adjustment should be to the lowest level that works for your situation. Too high gain here can cause the receiver output to squeal and be unusable. The AUDIO output for headphones requires more amplification, which is provided using the "Audio Level" output volume control and connecting headphones or speaker to the "AUDIO" output jack.



INSPIRE VLF-3 Receiver Frequency Response Curve

What is frequency range that can be observed?
See the two curves for the INSPIRE receiver's measured frequency response, one with the high pass filter switched out and one switched in. With the filter "out" the frequency range is roughly 100 Hz to 15,0000 Hz. One would have to determine the noise floor for the receiving location as a function of things like nearby power line and power supply noise before knowing the frequency range that could be observed.

After setting up the INSPIRE receiver, I would like to know what software I need to use?
I use Spectrum Lab (https://www.qsl.net/dl4yhf/spectra1.html), but there are several packages available and some operating systems can capture sound. The receiver is sensitive up to about 15 kHz so recording with a sample rate of 48 kHz is plenty. This software can record audio and display it as amplitude as a function of time or as frequency versus time with the amplitude color coded.

Will the VLF receiver only work if I go way out away from building and power lines?
The receiver works even when close to power lines, but too close and the RF from power lines will overwhelm listening to natural radio noise. Except for the strongest spherics, it will dominate what you can hear from the receiver. By going away from power lines, 1 km or more, that noise becomes much weaker, making it possible to listen to the natural radio noise.

VLF Online Resources

YAHOO VLF DISCUSSION GROUP
https://groups.yahoo.com/neo/groups/VLF_Group/info

VLF GRAPH CONVERSION SOFTWARE
Spectrum Lab: http://www.qsl.net/dl4yhf/spectra1.html

VLFrxTools: http://abelian.org/vlfrx-tools

LOCAL TIME TO UTC CONVERSION
http://www.worldtimeserver.com/current_time_in_UTC.aspx

To Purchase an INSPIRE VLF-3 Kit & Download Assembly Instructions and Observation forms
http://theinspireproject.org/default.asp?contentID=3

INSPIRE VLF-3 Kit Questions
CustomerService@TheINSPIREProject.org

INSPIRE Journal VLF Observations/Article Submissions:
Editor@TheINSPIREProject.org

Share Your VLF Observations in *The INSPIRE Journal*

The INSPIRE team invites you to share your VLF observations with our readers. Describe your experience, including any comments that relate to carrying out your field observations. Field photographs and spectrograms are welcome components along with a short bio and photo to accompany your submission. All submissions are reviewed prior to publication.

Thanks to INSPIRE VLF Chief Technical Advisor Dennis Gallagher

Dr. Dennis Gallagher is a Senior Researcher in the Science Research Office at NASA Marshall Space Flight Center and serves as INSPIRE's Chief Technical Advisor. Dennis answers VLF kit users' technical questions. He has been actively involved with the organization since it was founded in 1989.

Dennis with the INSPIRE Total Solar Eclipse team conducting VLF research prior to the Eclipse on a soybean farm in Guthrie, Kentucky in August 2017


Photo courtesy of
Tony Bateman (Finland)

INSPIRE VLF-3 Radio Receiver Kit Ordering Information

INSPIRE VLF-3 Radio Receiver Kits can be ordered online at:
www.TheINSPIREProject.org

INSPIRE accepts purchase orders for multiple kit orders. Discounts are available for non-profit organizations utilizing kits STEM curriculums.

For more information email: CustomerService@TheINSPIREProject.org

Invest Today for the Exploration of Tomorrow

In 2009, The INSPIRE Project expanded its STEM educational programs to provide scholarships and internships to educators, middle/high school students, and university students to ensure the next generation of space science and technology explorers. INSPIRE's team is comprised of dedicated board members and advisors who volunteer his/her time to make it possible for INSPIRE to continue fulfilling its expanded mission of providing students the resources to pursue study in STEM disciplines. If you would like to make a life-changing gift, please visit: www.TheINSPIREProject.org.
Donations are tax-deductible.

For more information about individual and corporate giving opportunities or volunteering, please contact INSPIRE Program Manager:
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Photo by Eva Kloostra, U.S. Space & Rocket Center ~ Huntsville, AL

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