



Doc # 19

Amateur Radio on the International Space Station

Committee Report to the ARRL Board of Directors

January 2022

Submitted by:

**The 2021 ARRL ARISS Committee,
VD Tharp, Chairman**

ARRL ARISS Committee Members for 2021

Vice Director Tharp (Chair)

Vice Director Schilling

Vice Director Nelson

Vice Director Temples

Mr. Kris Bickell until leaving ARRL Hq in Sept. (staff member - Lifelong Learning Manager)

Ms. Rosalie White, K1STO (Consultant - ARRL representative to ARISS)

Summary of ARISS Program

Amateur Radio on the International Space Station (ARISS) is a well-known international working group that promotes STEM education and Amateur Radio. In 1996 the ARRL CEO tasked ARRL Headquarters staff to meet NASA's challenge to set up just 1 worldwide ISS ham radio team. The staff, working with AMSAT-NA, set about establishing ARISS-International. The ARRL has been an ARISS sponsor since 1996. ARISS was built on the shoulders of human spaceflight radio activities since 1983 when international amateur radio organizations worked with space agencies to fly Amateur Radio to support educational and ham radio activities on the Space Shuttle (SAREX), Mir (Mirex) and the ISS (ARISS).

The ARRL-led portions of these projects have always included leadership roles, advice to ARISS on items related to FCC regs, and Public Relations support and some education activities related to school radio contacts and outreach.

Each year ARISS helps astronauts earn ham licenses and make hundreds of Amateur Radio school contacts. The educational activity puts Amateur Radio in the lives of students, educators, media, communities, and political leaders.

Hams are proud to know astronauts are licensed hams. Hams enjoy making thousands of Amateur Radio contacts using ARISS packet each year, and in 2021, hams began making thousands of FM voice contacts with ARISS's new cross band repeater. Hams capture ARISS SSTV images downlinked by the ISS crew, too—over 10,000 each year.

ARISS-USA, a 501(c)(3) as of 2021: In 2020, ARISS leaders in the US began the process to set up ARISS-USA as a 501(c)(3) group. This was completed in March 2021. The ARRL ARISS Committee has continued to work well with ARISS during the transition and afterwards. ARISS's 501(c)(3) status benefits both organizations.

Authorizing Board Motion to Establish the ARRL ARISS Committee, Minute 27, January 2019

In January 2019 the ARRL Board of Directors established the ARRL ARISS Committee and tasked it with improving ARRL's support to the ARISS program. The wording of the ARRL Board motion follows.

Be it therefore resolved: A permanent ARISS committee is created by the Board to develop an interactive relationship with ARISS. Said committee should consist of three members of the Board, with assistance of the ARRL Lifelong Learning Manager and the ARRL Communications Manager as consultants, all to be appointed by the ARRL President. The committee will recommend the framework under which the ARRL will support ARISS to include recommendation of the ARRL representative to ARISS, standardized mission support, operational needs, ongoing mentoring and assistance to local Amateur Radio clubs in support of ARISS contacts, and a standardized set of Public Relations messages to ensure consistency of the ARRL message to ARISS, local Amateur Radio groups and the public at large.

Photo below: At the Huntsville Hamfest, ARRL Southeastern Vice Director Jim Schilling, KG4JSZ, in ARISS's exhibit booth, talking with his constituent and acquaintance, ARISS volunteer Dave Jordan, AA4KN from Orlando.



2021 ARISS Successes Map Out the Near Future, and It is Bright!

People sometimes discuss how long the ISS will be operational. The US Senate passed a NASA authorization bill in 2021 to fund the operation and maintenance of the US segment of the ISS through 2030; the House has not finished their version of the bill. The Biden administration's 2022 budget increased support to NASA by 6% over 2021, citing science and research (much of it done on the ISS) as important. NASA's top administrator said it was: "the largest budget request for NASA science, ever."

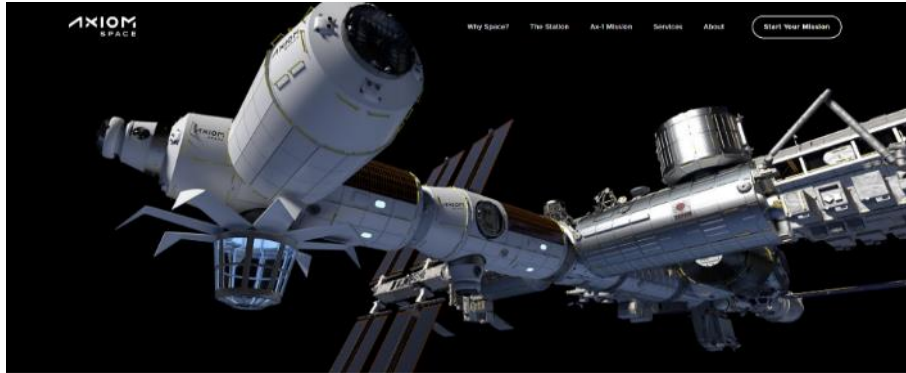
In 2020, Rosalie White had reported to the ARRL ARISS Committee that ARISS leaves no good stone unturned when preparing for the future. ARISS had already begun working on a relationship with Axiom Space—two of its leaders had been with NASA previously and knew ARISS quite well. NASA had a meeting in Houston with Axiom and kindly invited ARISS's Frank Bauer to discuss ARISS educational events and long-term ideas of having an ARISS radio system in an Axiom space module.

In early 2021, Ms. White reported to the ARRL ARISS Committee that Axiom was building a commercial space module that docks to the ISS (maybe 2024) and ultimately, a few years later it could undock as a free-flying space station. *Meantime, Axiom's first astronauts will fly to the ISS, possibly in March 2022, to do research on the ISS and hope to do ARISS contacts!!*

In June 2021 ARISS had talks with the first few Axiom astronauts about ARISS educational activities. In August, these private astronauts began astronaut training at Johnson Space Center. In October, ARISS team member Kenneth Ransom who works the ARISS matters at Johnson Space Center, trained those astronauts on the ARISS radio. Other ARISS volunteers mapped the best ways to help these Axiom astronauts (Canadian and Israeli) get licensed during December

2021 and January 2022. One from the US is already licensed. On Dec.14 and 16, 2021, the two Israelis passed their exam.

Below: An Axiom depiction of a future space module



ARRL ARISS Committee Activities from July 1st to December 31 2021:

In the second half of 2021, the ARRL ARISS Committee continued to do nearly all business by email. The Committee met via Zoom in October where Ms. White gave Committee Members a thorough review of the report ARISS provided to NASA covering July and August—after the review, a lively worthwhile discussion ensued. Ms. White and VD Tharp had phone calls with each other every 2-3 weeks.

The Committee appreciates that Ms. White continues to notify Directors, Vice Directors, and Section Managers in the respective divisions and sections where ARISS radio contacts will take place. She shares what STEM- and ham-related activities each school planned to do, and what schools established student ham clubs.

With Covid abating in some parts of the world in July through fall, some ARISS radio contacts could be direct from a school to the ISS and back. Other schools incorporated a hybrid model based on their Covid status—social-distanced students at school and hundreds in the school’s outdoor areas or online. As Covid picked up in cold weather, the Multipoint Telebridge Contact via Amateur Radio became the choice of many schools and groups.

ARRL and ARISS Publicity

The Committee continues the cooperation between ARRL and ARISS on ham radio PR. Ms. White forwards ARISS media hits to Mr. Inderbitzen who gets many of them posted on ARRL web pages. From July to December, Ms. White forwarded 19 media hits, some from major markets. The rundown of media hits is in Appendix B.

When appropriate, Rosalie White composes 1-2 page summaries for the Committee of ARISS successes that are of particular interest to ARRL. Examples include a summary of the great outcomes at ARISS US schools doing hours and hours of wireless radio lessons for every student enrolled in the facility. Or NASA postings that get many viewers.

Screenshot -- example of Social Media posting by astronaut talking on the ARISS radio



Ms. White forwards all ARISS news releases and other interesting facts to the Committee and Mr. Inderbitzen. Examples of these topics are: new ARISS leader volunteers, scheduled ARISS SSTV events, dates for mode changes of the ARISS radio (packet, cross band repeater), and more. ARRL chooses which news releases could interest ARRL members and Mr. Inderbitzen facilitates the writing and posting of ARRL web stories about the news, most of which get fact-checked by Ms. White. Many of the stories also run in *The ARRL Letter* and often in *QST* "Happenings." A few of the ARRL stories prepared from ARISS news and press releases sent to the Committee include:

- ARISS supporting the first-ever ARISS radio contact for a school for the deaf
- ARISS having added 5 new volunteers to its leadership team
- ARISS SSTV sessions so popular with ARRL members, SWLers, students, and space enthusiasts who download anywhere from 900 to 12,000 images during each session
- ARISS winning the Amateur Radio Newsline International Newsmaker of the Year Award for 2021.

Amateur Radio Newline bestowed this award on ARISS on December 6, stating: “Newline recognizes ARISS in 2021 for opening the wonders of the International Space Station to children around the world through amateur radio through ‘linkups’ with astronauts and cosmonauts for more than 20 years.”



The ARISS news releases about upcoming schools that went to the Committee allow them the chance to watch the livestreams. For radio contacts in the US, the links and releases were shared with the respective Directors, Vice Directors, and Section Managers. ARRL continued to experiment with posting the livestream URL and even the video on ARRL Facebook and Twitter.

ARRL Assistance with Soliciting Donors to ARISS

The Committee requested that revisions be made to the ARISS ad in *QST* that solicits donations and this was completed just prior to the first 2021 Board Meeting. Additionally, a second version, a smaller one, was created for times when *QST* had empty ad spaces too small for the larger ad. The Committee approved the ad that was created. The ARRL Hq staff was able to run the full-column length ad in October and November; ARISS is grateful. Ms. White handles the tracking and acknowledging of donations to ARISS. A very good donor wrote the following to her, which she reported to the Committee:

"I saw the ad for ARISS donations in QST magazine. My hope is that my donation helps provide things to future generations which help spark their interest in amateur radio, NASA and space exploration. I will give the ARISS Challenge Coin to one of my grandkids—I've been teaching the oldest about space and radio communications."

Image: Smaller ARISS ad for times when there is a small empty ad space in *QST*



The Committee had proposed having a slider ad created about ARISS so that it could be run on the ARRL web pages. This project was completed and the ad first ran just prior to the first ARRL Board Meeting. It ran again for most of September. Shortly after it went live, Ms. White received several donations that cited the slider ad. She reported this to the Committee and thanked them and ARRL for assisting ARISS in this way.

Screenshot of ARRL web page slider ad about ARISS



Other ARRL Assistance

The Committee worked together in October to update the ARISS information in the ARRL Section Manager Workbook that educates all SMs. The Committee was pleased that Ms. White also continued to forward news releases to Mr. Ewald about ARISS windows opening to accept ARISS school education proposals (required to garner ARISS contacts). He distributed the releases to SMs.

VD Tharp assisted Ms. White in solving the problem of her not receiving emails. She profusely thanked him and the IT staff, which continues to assist with this when needed.

ARISS Fundraiser

In the late fall of 2020, Vice Director Tharp started a dialogue with CEO minster about ARRL possibly facilitating an email fundraiser. This project is ongoing and after a year of discussion, should be going out to members in the first half of 2022. The target will be existing donors to the League with the funds going directly to ARISS via a webpage link. ARISS will set up and host the webpage and ARRL will simply send the email and provide the link to the donation page. The funds for this will be specific for the ARISS *STAR* Keith Pugh Memoriam Project (see Appendix C). The cost of this to ARRL will be negligible with only a small amount of staff time involved for the email.

The *STAR* project involves telerobotics somewhat similar to the ARRL MAREA program. VD Tharp assisted ARISS in getting a draft of an agreement for ARISS to convert the MAREA source code to enhance it. In years past, ARISS had helped with MAREA beta-testing. Now, ARISS's major big modifications to the source could allow ARISS to design an expanded ARISS Radio Experimenter's Kit.

ARISS Contacts in the US in July to December 2021

US ARISS radio contacts made during the period in addition to other countries were:

- YOTA Region 2 – Cincinnati OH
 - Space Kids Global – Winter Park FL and hundreds of Girl Scouts from around the US
 - Children's National Hospital – Washington DC but also youth from around the US
 - 5 elementary & middle schools in Prescott Unified School District – Dewey AZ
 - Tarwater Elementary School – Chandler AZ
 - Savannah River Academy – Grovetown GA (2 teachers attended Teachers Institute)
- Soon to follow: Lewis Center for Educational Research – Apple Valley CA

Recent ARISS schools that have set up ham clubs are: Mile High Middle School in Prescott AZ, Estes Park Middle School in Estes Park CO, and Sussex County Charter School in Sparta NJ.

At most ARISS contacts, students are at school and some are home watching the livestream (usually 1,000 to 2,000 live views). ARISS mentors urge schools to show the ARRL video produced by Tom Delaney. Also, at most ARISS contacts the ARRL diamond is on display.

ARRL ARISS Committee Travel Budget for ARISS at Conventions, Conferences

During second-half 2021, ARISS used budget monies earmarked and provided by the ARRL for travel to a ham convention and a teacher conference. For the first trip, three ARISS team members went to the ARRL Southeastern Division Convention/Huntsville Hamfest. ARISS rented a booth and engaged with 290 hams drawn in by a working model of the ARISS radio system and also the ARISS Radio Experimenter's Kit. The ARISS roll-up banner that the ARRL funded for ARISS was prominently displayed. ARISS secured forum time and 24 people attended. Frank Bauer had a fruitful discussion with David Minster. Bob Inderbitzen taped an impromptu video of ARISS volunteer Ruth Willet visiting the ARISS booth; he panned the booth while she glowingly described her experiences at the YOTA ARISS contact. The video was posted on ARRL's web site; viewers totaled 1,182.

Photo below: David Minster and Frank Bauer planned a chat at the Huntsville Hamfest and found a few minutes of slow time for it just before Mr. Minster left to fly home.



Some travel money earmarked and provided by ARRL for ARISS to present at a 2021 educator conference was used for an ARISS/ham radio talk at the National Science Teachers Association (NSTA) Conference on Science-West in Portland, OR. An ARISS educator gave her forum talk to 43 educators about what amateur-radio-related STEM activities her students enjoy, including Morse code. Another ARISS educator gave an ARISS talk at the National Science Teachers Association Conference on Science-East in National Harbor, MD. She spoke to 41 educators about ham- and ARISS-related STEM activities she leads in her nearby high school. The ISS National Lab covered her entrance fees. NSTA gave all registrants access to all recorded talks for a month, including these two talks, and over 100 more educators viewed both talks.

ARRL Second-Half 2021 Outreach Events, Many with ARRL's Help

- Matanuska Hamfest AMSAT/ARRL forum – Big Lake AK – Mark Tharp participated
- Tank Radio, an ARRL talk – Featured speaker Ria Jairam, describing a NJ ARRL school contact
- July Teachers Institute, ARRL talk by an ARRL educator – virtual
- Sussex Co. (NJ) Charter School ham learning activity, Ria Jairam mentored students
- Savannah River Academy Get-on-the-Air Day – Grovetown GA, ARRL Georgia Education Coordinator Martha Muir mentored
- NASA STEM-a-thon, virtual ARRL presentation – nationwide audience
- AIAA ASCEND Conference, virtual ARRL presentation – nationwide audience
- American Society of Gravitational & Space Research, ARRL exhibit – Washington DC
- AIAA Orange Co. Annual Conference, ARRL talk – Los Angeles CA
- CARAFest ARRL exhibit – Columbia MD
- Melbourne Hamfest ARRL forum – Melbourne FL
- U of Ala-Huntsville undergrads mentor Buckhorn Middle School youth in ARRL STEM
- English Estates Elem. School, ARRL STEM lessons to all 5th graders – Fern Park FL
- East Coast Chapter Tuskegee Airmen Youth, ARRL talk – Baltimore MD
- Festival for Vets ARRL exhibit – Lancaster OH
- New England ham radio clubs, ARRL talks – New England states
- Livonia Library, ARRL talk – Livonia MI

Photo: Sussex Co. (NJ) Charter School students got 2 full days of learning activities about many, many aspects of Amateur Radio activity; Ria Jairam helped mentor students.



Photo: Savannah River Academy (GA) girls & boys like Morse, especially with an Altoid's tin.



ARISS regularly thanks ARRL for its continuing support and for the generous funding it has provided for 2021 and in earlier years; ARRL's sponsorship is great appreciated.

Respectfully submitted,

Mark J. Tharp, KB7HDX
ARRL ARISS Committee Chair

Rosalie White, K1STO
ARRL ARISS Representative

Appendix A:

Crew that Most Recently Arrived on the ISS – *ALL HAMS!*

ARISS recruited this crew to become hams to help support ARISS radio contacts. ARISS trained them to operate the radio system. These 4 astronauts are taking part in ARISS contacts *right now*:

Matthias Maurer, KI5KFH

Thomas Marshburn, KE5HOC

Raja Chari, KI5LIU

Kayla Barron, KI5LAL



Appendix B:

Media Hits

SanTan Sun News, Chandler AZ

This article had an error and VD Tharp contacted the writer, who corrected the error!

<https://santansun.com/2021/11/08/tarwater-kids-connect-with-astronauts/>

Prescott Courier, Prescott AZ:

This article cited Amateur Radio in the first sentence, has a photo of a girl in a NASA spacesuit

<https://www.dcourier.com/news/2021/oct/05/pusd-students-rely-amateur-radio-science-contact-i/>

Arizona State University News:

<https://news.asu.edu/20211217-asu-russian-lecturer-student-prepare-kids-chat-astronauts>

The Sparta Independent, Sparta NJ

'Is there anybody out there?' Sussex County Charter School selected to contact space station

YOUNG LIFE. At the school's first-ever amateur radio camp, "Making Connections," students talked to other radio operators from around the country and world.

By MaryLou DeCuprio

Ham radio is truly the ancestor of the cell phone. It's all about antennas capturing radio signals, delivering them and receiving them.

The Sussex County Charter School for Technology's first-ever amateur radio camp, called "Making Connections," fostered student engagement and creativity with hands-on activities.

Held last August, the camp started out with some electronic basics for students in grades 6 through 8 and progressed to ham radio, learning about its evolution and current uses.

Charter hosted guest licensed amateur radio operators who spoke to the students about QSO's (radio contacts) and other applications of amate-

teur radio bands in the modern world.

Not only did the local Sussex County Amateur Radio Club members visit to present a talk about Morse Code, but the Nashua Area Radio Society president, Fred Kemmerer from Nashua, New Hampshire, rode down to remotely run his antenna and hosted some QSO's for us, whereby students got to talk to other radio operators from around the country and world. He also led a "fox hunt" that was a special kind of scavenger hunt using hand held radio to find a hidden transmitter.

The students and their teachers also learned about how they can make contacts with other amateur radio operators through satellites in space.

We rounded off the week with the director of the Hudson County Radio Club, Ria Jaimin, who gave us a special presentation about an exciting application of radio use: drone flight, which is making its way into many businesses, from real estate to pesticide treatment to home deliv-

ery of packages, using a radio-operated remote control.

Why radio camp?

Why a ham radio camp? As Kemmerer states in his online newsletter, "The summer Radio Camp was a STEM education program that the school developed in support of their upcoming contact with an astronaut on the International Space Station (ISS)."

Last April, Charter was approved for an ARSS contact. ARSS stands for Amateur Radio on the International Space Station. It is a joint educational outreach program between amateur radio and the International Space Station to spark more STEM career interest in students. Every year, about 15 U.S. schools get chosen for such a contact, after submitting their proposals, competing with many other school proposals that have been entered.

Kemmerer is the school's ARSS-assigned equipment mentor and took on such a great interest in hear-

ing about Charter's camp that he decided to ride down in person to share his passion for radio communication with the teachers and students. The students' parents joined us on the last afternoon of camp to learn about amateur radio and view the showcased activities their kids had performed during the week.

As part of the Sussex Charter's intensive STEM program, the school has formed an amateur radio club dedicated to enriching the students' learning experience in the physical sciences. Located within the school facilities, the club and radio station will engage students in activities that will involve building an amateur radio station, provide licensing training courses for any student who wishes to earn an amateur radio license, and engage in local and worldwide communications with other amateur radio operators around the globe and through orbiting satellites.

Throughout this school year, in advance of the February astronaut

MORE ONLINE:

Fred Kemmerer's complete article, "Importance of Amateur Radio in Schools," can be found at the Nashua Radio Society's online newsletter (tinyurl.com/j69rpfm4).

Interested in writing your own proposal for an ISS radio contact? Visit Hosting an ARSS Radio Contact at ariss-usa.org/hosting-an-ariss-contact-in-the-usa.

contact, teachers will be infusing more activities involving communication, space exploration, and collaboration into all subject areas. Charter is forming its own licensed radio club and students will have the opportunity to take a course that will ultimately allow them to become licensed amateur radio operators.

Editor's note: MaryLou DeCuprio is a middle school science/STEM teacher at Sussex County Charter School for Technology and a science blogger.

WDRW-TV Channels 12 and 26, Augusta GA -- TWO stories

Article announced the upcoming Savannah River Academy ARISS contact, describing students engaging in special curriculum over 6 months to prepare, studying basic electronics, radio communications, and code along with lessons on space. The TV station ran a second story on how well the ARISS contact went.



<https://www.wrdw.com/2021/12/07/local-students-will-get-talk-space-station-astronaut-this-week/>

and

https://www.wrdw.com/2021/12/11/local-students-talk-international-space-station-astronaut-its-just-once-lifetime-opportunity/?fbclid=IwAR25EnDXqPtDGoLTxxS6oivaH4z9xkmji0Y_y3u2blbOkjvMJn4U_t0lYo8

Bollyinside

This news outlet ran a short story about the Savannah River Academy ARISS contact.

[Local students talk to the astronaut of the International Space Station - Bollyinside](#)

<https://www.bollyinside.com/news/local-students-talk-to-the-astronaut-of-the-international-space-station>

The Augusta Chronicle, Augusta GA

Another story on Savannah River Academy ARISS contact, on the 1st day, included a video clip

<https://www.augustachronicle.com/story/news/education/2021/12/11/savannah-river-academy-students-speak-astronaut-space-station/6415832001/>

Yahoo!Money

More news for Savannah River Academy

<https://money.yahoo.com/10-minutes-omg-savannah-river-125121361.html>

[ISS astronaut takes live student questions from Savannah River Academy - The Augusta Chronicle](#)

The Augusta Press (subscription was required to access story on Savannah River Academy)

<https://www.theaugustapress.com/savannah-river-academy-students-interview-astronaut-aboard-the-international-space-station/>

WJBF Channel 6

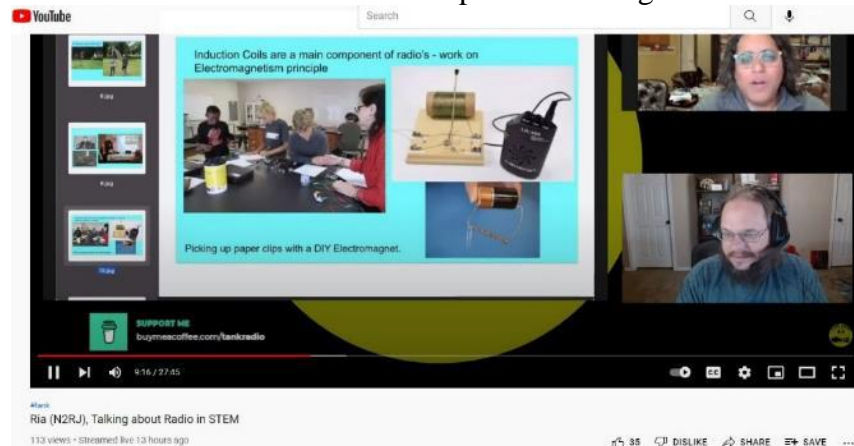
Story with great video, shows ham radios

https://www.wjbf.com/news/education/grovetown-students-speak-with-astronaut-onboard-iss/?fbclid=IwAR0-by4fFhacj0QaP90OugoREwaRONIXKQJwexggc5_OdFSsqkPNaCryyGO

Podcast:

The Tank Radio show - November 29th featured ARRL Hudson Division Director Ria Jairam talking about ARISS. She described for 113 viewers the upcoming ARISS contact for Sussex County (NJ) Charter School for Technology and how ARISS works. She highlighted many of the Sussex County students' STEM activities related to ham radio. Ria has been mentoring the students in aspects of wireless radio in preparation for their contact.

Screenshot: Ria Jairam featured in podcast talking about ARISS



Popular New Book with Excerpt on ARISS

ARRL learned in November that Astronaut Eileen Collins gave ARISS a shout-out in her new memoir, *Through the Glass Ceiling to the Stars*. Here's the quote:

“Astronauts love SAREX, the Space Amateur Radio Experiment program. (We call it ARISS these days, for Amateur Radio on the ISS.) We use ham radio technology to communicate with school students on Earth. It’s highly motivational for the astronauts, as we get to take a break from our other tasks and talk with children from across the country who are interested in space. And, of course, the students enjoy speaking with astronauts in space! The sessions have to be tightly scheduled, as we are only within communications range of a participating school for about ten minutes.

“When we reached the appropriate time in our schedule for my first session, I called down to the school. (My call sign was KD5EDS.) Despite repeated calls, my voice wasn’t going through. Ten minutes came and went without my being able to connect, and then we were out of range. I knew the students on the ground were disappointed they couldn’t talk to us. I went back over the checklist. I discovered that I’d missed a step and left a circuit breaker open.”

NASA was able to re-schedule the school contact not long afterward and it was a huge success!



Two NASA Online Posts Featuring ARISS

Dec. 7: A photo of Raja Chari speaking with students using the ARISS radio system on board the ISS was posted in the NASA Science online publication, *Space Station Science Highlights*.



Recovering more water

The JEM Water Recovery System is an investigation from the Japanese Aerospace Exploration Agency (JAXA) that tests a technology to increase the recovery of drinkable water from urine. Adequate water supply could be a limiting factor on future long-term missions, and future water recovery systems need to be smaller, recover more water, and use less power than those currently in use. This technology could be a vital part of the Environmental Control and Life Support Systems (ECLSS) on spacecraft and provide water regeneration in dry regions or after disasters on Earth as well. Crew members conducted operations for this technology test during the week.

Other investigations involving the crew:

- **INSPIRE-4** studies magnetic assembly of structures from colloids, or particles suspended in a liquid in microgravity. Results could lead to more advanced materials for space applications, including thermal shields, protection from micrometeorites, energy production, and sensors for robotic and human missions.
- **ESA's Acoustic Diagnostics** investigation tests the hearing of crew members before, during, and after flight to assess possible adverse effects of noise and the microgravity environment on human hearing.
- **ISS Ham Radio** provides students, teachers, parents, and others the opportunity to communicate with astronauts using ham radio units. Before a scheduled call, students learn about the station, radio waves, and other topics, and prepare a list of questions on topics they have researched.
- **HRF** Vesp focuses on the overall health benefits to crew members of having various plants and fresh food available. The investigation uses psychophysical



NASA astronaut Raja Chari participates in an ISS Ham Radio event along with students at Gregg Punnett-Fennell in Temec, Ohio, October, NASA/GSFC

November 19: *NASA Space Update* ran an item about the ISS crew using the ARISS radio system to talk to students at the South Yarra Primary School in Australia.

NASA SPACE UPDATE FOR NOVEMBER 19



Team,

We want to start with a huge "Thank you!" to the International Space Station operations team that did such a great job protecting the crew this week!

Kathy has returned from planned travel to Russia for technical discussions regarding ongoing space station operations, including flying integrated crews as early as fall 2022 to ensure safe and continuous operations on the space station. In other news of progress, the Northrop Grumman Cygnus is scheduled to undock from ISS this weekend, and Launch Services and the Science Mission Directorate are on track to launch the Double Asteroid Redirection Test (DART) mission next Wednesday, November 24. Meanwhile, Artemis I continues to move into some planned program-specific testing. Over last weekend, teams completed excellent work on the engine section to continue to closeout that critical element.

We are still on track for reviewing with management the next level features of the new organization. Also, we are happy to announce that Ms. Tawanna Powell has joined our NASA family and will serve as Jim's administrative assistant. Tawanna comes to us with extensive experience at the executive level and will be a great add to our team. Please join us in welcoming Tawanna!

We appreciate everyone's patience and continued progress on the missions we are conducting. We hope everyone has a great Thanksgiving.

Kathy and Jim



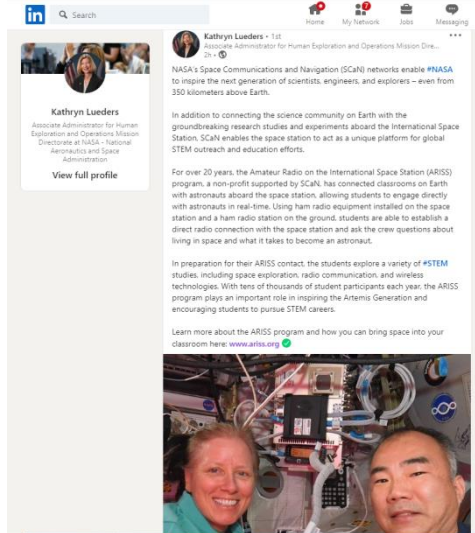
Last week, station crew members conducted an **ISS Ham** session with South Yarra Primary School in South Yarra, Victoria, Australia. This experience helps inspire interest in science, technology, engineering, and math.

ISS Ham Radio engages students, teachers, parents, and other members of the community in direct communication between astronauts and ground-based ham radio units. Before a scheduled session, students learn about radio waves, amateur radio, and related science topics and conduct research to prepare their questions for the crew. Over the past 21 years, more than a quarter of a million people have participated in station HAM radio contact.

Explore more stats from the past [21 years](#) of ham radio on station.

LinkedIn post

A LinkedIn post on September 3 about ARISS by NASA VIP Kathryn Lueders (Associate Administrator for Human Exploration and Operations Mission Directorate) Picked up by 10 e-news outlets, some national, some regional, including several ARRL Section web sites. LinkedIn Reactions totaled over 100 aerospace industry professionals.



The Milano, Milan, Italy Feature article on ARISS volunteer and school teacher



School's Social Media Posts

Every ARISS school posts numerous items about their ARISS contact on Facebook and Twitter. These are too numerous to list.

Appendix C:

ARISS *STAR* Keith Pugh Memoriam Project -- Space Telerobotics using Amateur Radio

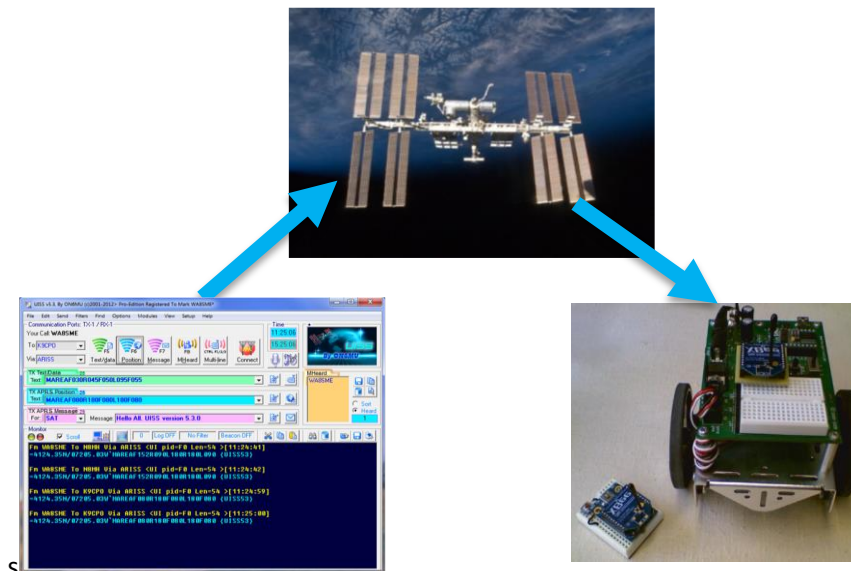
ARISS-USA completed writing and submitting a grant proposal in October to the ARRL Foundation for a new K-12 STEM education experience called ARISS *STAR*-- Space Telerobotics using Amateur Radio. The full name of this 2-year project is: **ARISS *STAR* Keith Pugh Memoriam Project** and on Dec. 15, 2021, the ARRL Foundation approved \$47,533 for year 1. The name honors highly-respected Silent Key Keith Pugh whose call sign was W5IU. For many years, he was a star ARISS Technical Mentor who also set up talks about ARISS to interested educators, led youth in varied wireless radio lessons, and gave generously to ARISS.

But funding is needed for year 2 of the project. Thus, this document is being shown to ARRL Inc. to consider possibly funding year 2.

One of the *STAR* experiments would allow students to learn wireless control of robots from a distance—next door, at another school, cross country, and some from the International Space Station. NASA has proposed its Lunar/Mars simulated terrain course for use as part of *STAR* , too.

ARISS *STAR* youth who become telerobotic control experts will be inspired to perform long-distance (~500+ mile) telerobotic control with one another, using the ARISS radio on the ISS as a command relay. This would require a youth to earn a ham license or ensure an ARISS ham volunteer is a control op.

ARISS *STAR* Concept



The ARISS *STAR* Plan

The project would span 2 years. The first year ARISS will work with university faculty and students. The second year, university students and ARISS would work with youth. To meet the goals of the ARISS

STAR proposal, ARISS hopes to leverage an amateur radio telerobotics system that was beta tested by volunteers, thanks to the ARISS team getting NASA's approval to use ARISS's ISS ham station for the testing. These tests demonstrated long-distance telerobotic control.

ARISS *STAR* would offer an expandable set of hands-on telerobotic activities to inspire, engage, and educate disadvantaged youth at 5 organizations. Experiential learning derived from *STAR* activities will demonstrate that avocations and careers in STEM are exciting; youth will experiment with radio, telerobotics, space communication, and computers. Using the recently developed ARISS Radio Kit, augmented with enhanced telerobotics systems and lessons created thanks to this proposal, *STAR* youth would complete a series of hands-on education activities tied to the ARISS ham station on the ISS. Youth would begin with radio and robot technology fundamentals leading to on-orbit experiments of radio-commanded robot "cars" over closed courses developed by ARISS. Youth would execute digital packet radio commands from their team's Mission Control Center to manipulate cars at other *STAR* organizations, nearby, then far. When youths are proficient, they will be challenged to improve their accuracy and timing through contests with other *STAR* organizations.

ARISS is requesting an agreement with ARRL Inc. for ARISS to convert code that was beta-tested with help from ARISS for MAREA. The converted code would update the ARISS Radio Pi (Raspberry Pi) in the ARISS Radio Kit. Prior to student activities described earlier, ARISS *STAR* will engage an ARISS university partner's students in hands-on learning by developing and deploying real-life student education flight operation and an ISS experiment with the ARISS ISS radio. Undergrads would assist ARISS education's team with *STAR* activities, lessons, and closed courses using the ARISS ham station, and with porting the beta-tested software system with updated code for the ARISS Radio Pi.

An updated ARISS Radio Pi together with a wireless radio interface will make up each *STAR* youth organization's ARISS *STAR* Mission Control Center. ARISS education and operations teams will provide hands-on volunteer support to youth groups--technical setup, ops, and lesson activities. ARISS *STAR* can be implemented in both formal and informal educational settings.

Contents of ARISS Radio Kit & *STAR* Deliverables

The ARISS Radio Kit has 5 educational elements, 5 separate teaching modules. These include:

- 1) Understanding Radio Waves
- 2) Electronics Investigation: Series and Parallel Circuits & other electronic projects
- 3) Codes and Ciphers
- 4) Software Defined Radio using the ARISS Radio Pi
- 5) Employing the ARISS Radio Pi: Capture signals from the ISS Ham Radio
 - a. Understanding orbits and ISS orbital passes
 - b. APRS—Packet Radio "Text Messaging"
 - c. SSTV (Slow Scan Television)—capturing images from the ISS

Each element of the kit has corresponding equipment, instructions, and grab-and-go educational activities. For some elements, YouTube video tutorials are provided.

The proposal's scope for student engagement with the ARISS ISS radios in on-orbit experiments offers:

- 1) Basic understanding of wireless technology, ARISS station, ARISS Radio Kit, ARISS Radio Pi

- 2) Ground-based experimental mode of on-orbit ISS activity
 - Use ***STAR*** platform with up to 2 robots and 1-2 ground stations, undergrad closed courses
 - Ground stations sending commands to other locales
 - Group to group contests - timing and accuracy contests
- 3) On-orbit experimental mode using the ARISS ham station on the ISS
 - Two education organizations use APRS ground station to command each other's robot
 - Universities and schools provide feedback on the on-orbit ISS experiment

ARISS *STAR* Measurables

ARISS will perceive breadth and depth of educational learning derived from activities and student guides:

- Pre- & post-survey materials developed for each activity lesson by university students and leaders
- ARISS-planned student events for organizations with activity reports afterwards
- Feedback. ARISS wants to improve the project, have more youth organizations engaged each year.