National Aeronautics and Space Administration

ARISS

AMATEUR RADIO ON THE INTERNATIONAL SPACE STATION

PROPOSAL GUIDE

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Preface

About This Proposal Guide

Who Should Use this Guide?
This planning guide is intended for educators interested in hosting an Amateur Radio on the International Space Station (ARISS) contact in the United States and its territories.

About ARISS

What is an ARISS Contact?
An ARISS contact is an opportunity for students and educators to interact with the crew aboard the International Space Station (ISS) through a 10 minute question and answer session. ARISS contacts are conducted using amateur radio.

Figure 1: Astronaut Douglas Wheelock using amateur radio aboard the International Space Station

Scheduled ARISS contacts are conducted either by direct contact or telebridge contact (See technical section for more details). The method used will depend on the radio station equipment and experienced radio amateur volunteers available to support the contact as well as technical issues related to the orbit of the ISS over the contact location.

ARISS contacts are large-scale, public events and are ideal for a variety of forums such as school assemblies, science centers and museums.

Why does NASA provide ARISS contacts?
ARISS contacts use the unique experience of human spaceflight to afford audiences the opportunity to learn first-hand from space explorers what it is like to live and work in space. These events are designed to encourage students to study and pursue careers in STEM.

In addition, ARISS provides an opportunity for students, teachers and the general public to learn about wireless communications technologies and the capabilities of amateur radio, encouraging students to further explore these technologies.

This planning guide offers information about the process and requirements to host an ARISS contact. Direct questions or comments to Teaching From Space at: JSC-TFS-ARISS@mail.nasa.gov or (281) 244-1919.

Section 1: Getting Started

Fitting the Opportunity

Is my organization a good fit for this opportunity?
An ARISS contact may be a good fit if your organization:

- is a formal or informal education institution or organization.
- has the ability to adapt to ARISS date and time changes.
- has flexibility regarding pre- and post- ARISS contact educational activities.
- has the ability to develop a strong ARISS contact education plan.
- can secure a large student and educator audience.
- can assemble a team to handle the education, media, technical and evaluation components of an ARISS contact.
- has the ability to establish community partnerships.

How do I maximize this opportunity?
Think of the ARISS contact as part of a much larger vision. Use the ARISS contact to:

- Bring STEM subjects alive for students through an educational plan that includes investigation of multiple topics dealing with space exploration, space research, space and communications technologies leading up to and following the event.
- Enhance or create new partnerships with local businesses and community leaders.
- Attract widespread attention to your organization.
- Support local education objectives and initiatives.

Understanding the Proposal Process

What do I do first?
The first step is to decide if your organization is a good fit for this opportunity. If so, read this planning guide thoroughly.

Then what?
Submit a proposal. Proposal forms are available at www.nasa.gov/education/tfs/ariss.
Please not that due to limited contact opportunities, NASA is not able to accommodate all proposals.

Completing a Strong Proposal

What are some tips to completing a strong proposal?

- Integrate NASA Education and ARRL content with surrounding education activities. Links to a variety of NASA and ARRL resources are provided in Section 2 of this guide.
- Incorporate partnerships that have a lasting impact on the community.

- Brainstorm creative ways to maximize the ARISS contact reach and experience for students.
- Establish an evaluation plan that ensures a high percentage of participants will complete the NASA educator and student evaluations.
- Plan a comprehensive program of which the ARISS contact is only one component (refer to "Creating an ARISS Contact Education Plan" in section 2 of this guide).
- Keep date flexibility in mind. ARISS contact dates are driven by ISS mission requirements and are tentative due to the nature of human space flight.
- Proofread the completed proposal to make sure the information is complete and relevant.

The ARISS Proposal must include information on the instructional activities and lessons you will engage with your students as part of the learning and preparation for the ISS contact. The more advance preparation you make with educational plans, the more learning and value the ARISS event will have for students.

Evaluating the Proposal

How will the proposal be evaluated?
The proposal will be evaluated based on the following criteria:

- **Education**
  - Is the ARISS radio contact and surrounding comprehensive education plan useful to the education community, and does the plan strengthen the ability to engage students in science, technology, engineering and mathematics (STEM)?
  - Does the education plan include STEM and amateur radio activities?
  - Does the education plan include NASA resources and mission-related content?
  - Will the ARISS radio contact and surrounding education plan make a demonstrable contribution to attracting diverse students to careers in STEM?
- **Logistics**
  - Does the proposal demonstrate flexibility should an ARISS radio contact shift dates and/or times?
  - Does the proposal include a plan to ensure that a high number of participants will complete and submit the NASA evaluation and NASA educator and student surveys?
  - Does the proposal provide a clear overview of the contact including location that accommodates a large number of students, audience, transportation (if needed), and technology?
- **Outreach**
  - Does the proposal include a detailed media/outreach plan?
  - Does the proposal include plans to involve the community in the ARISS radio contact and/or education plan?
  - Is the overall event (ARISS radio contact, pre- and post-activities) designed to leverage partnerships with local, regional or national partners?

Section 2: Proposal Preparation: The Education Component

Creating an ARISS Contact Education Plan

What is an ARISS education plan?
An ARISS education plan is an overview of how the host organization will utilize the ARISS contact to enrich STEM learning activities, support local education initiatives and support NASA Education criteria. The plan should describe how the pre- and post-contact activities will tie into the 10 minute live contact with the ISS crewmembers.

How can you integrate this activity into the school curriculum?

- Match activities with State Educational Standards.
- Use an interdisciplinary approach to lesson development.
- Utilize cross-functional teaching teams.
- Engage multiple grade level participation.
- Broadcast over school's LAN, CCTV or PA system.
- Partner with local science oriented organizations, i.e. museums, clubs, and industry.
- Use year or semester long space themes.

What are some examples of classroom activities ARISS supports?

Amateur radio can be used to engage a variety of subjects. A chart that maps amateur radio connections to curriculum can be accessed at http://www.arrl.org/curriculum-connections-and-benchmarks.

Additional examples of classroom activities:

• Write essays • Write letters to astronauts • Create posters about space • Invite guest speakers • Develop questions for ISS event based on curriculum topics explored in preparation for the contact • Explore careers • Practice amateur radio operating protocols • Build an antenna for satellite communications • Make amateur radio contacts with amateur radio satellites and the ISS • Download data from NOAA weather satellites • Investigate electronics fundamentals • Explore microcontroller technology • Build robots that employ sensors for motion and data collection • Listen to amateur radio on-the-air demonstrations by local amateur radio club members.	• Grow "Space Seeds" • Give student-based public speeches about ARISS • Eat food the day of the event that the astronauts would eat • Use NASA online resources • Broadcast a Daily "Space Fact" over PA system • Keep a journal • Conduct a daily "countdown" PA broadcast until event • Establish an amateur radio club, assemble a radio station, get licensed and make amateur radio contacts. • Develop student news conferences • Create Web pages to report on preparations for the contact • Use satellite tracking software to track satellite orbits. • Find out when the ISS will orbit over your town and watch it pass overhead • Write a story of life in space • Build a simulated Space Colony

Accessing NASA Resources

What kinds of NASA Education resources are available?
NASA produces a variety of resources for educators and students. These education resources include websites, printed materials, student programs and professional development opportunities. The NASA Education resources listed below will help with writing the proposal and the creation of activities.

NASA Education Home Page
http://education.nasa.gov
This site serves as a gateway to information on NASA Education programs and services for educators and students. Educators can search for resources by grade level, topic, and type. The site contains numerous educator guides, posters and multimedia that will help provide information about NASA and space exploration that host organizations will find useful in planning activities for students.

NASA Digital Learning Network (DLN)
http://dln.nasa.gov
The goal of the DLN is to enhance NASA's capability to deliver unique content by linking students and educators with NASA experts. The DLN offers videoconferencing or Webcasting at no charge, providing interactive educational experiences to students and educators from kindergarten to university levels across the nation and around the world. Host organizations can utilize the DLN to connect to NASA for pre- and/or post-ARISS contact activities.

NASA has a special ARISS DLN module for students on its web site. Go to the following website to learn more about this program and click on the registration button to participate in the ARISS Digital Learning Network Program. http://www.nasa.gov/offices/education/programs/national/dln/events/HAM_It_Up.html

International Space Station (ISS) Homepage
http://www.nasa.gov/mission_pages/station/main/index.html
This site serves as the main homepage for the ISS. You can find the latest news on missions, ISS activities and resources.

Accessing ARRL Education Resources

What kinds of ARRL Education & Technology Program resources are available?
The Education & Technology Program offers three types of resources to teachers and schools. These education resources include resources for instruction (including kits and projects), professional development opportunities and grants for radio stations and related equipment.

Education & Technology Program
http://www.arrl.org/education-technology-program
Resources are available for educators to use to prepare their students for an amateur radio contact with the ISS. Foundational concepts of wireless communications, radio waves, the electromagnetic spectrum, wave forms and modulation, satellite communications, orbits, and Keplerian elements are a few of the concepts discussed.

Teachers Institute on Wireless Technology
http://www.arrl.org/teachers-institute-on-wireless-technology
This Institute offers a professional development opportunity which provides hands-on training for educators to learn about basic electronics, wireless communications, micro-controllers, programming

fundamentals and robotics along with resources for classroom instruction. Attending the Teachers Institute is a great way to prepare for an ISS contact through the ARISS program.

Listen to/watch ARISS Contacts
http://www.arrl.org/listen-to-watch-ariss-contacts
This website provides audio and video recordings of ARISS contacts that will give educators a good idea of how the contacts are conducted and the kind of conversations that develop between students and astronauts.

Using Amateur Radio in the Classroom
http://www.arrl.org/amateur-radio-in-the-classroom
This website provides information on using amateur radio in the classroom as an effective way to teach both fact and theory. Additional information is provided aligning ARISS with state and national learning objectives.

Accessing Additional Resources

What other NASA resources are available?
There are a variety of other NASA resources that host organizations could utilize in preparing for an ARISS contact. A TFS Education Specialist can help you identify further resources available to you.

Astronaut Appearance Requests
http://www.nasa.gov/about/speakers/astronautappearances.html
NASA astronauts appear before a variety of groups to inform the general public about the U.S. Space program. Requests must be submitted far in advance. There is a cost involved for the host, and appearances are very limited.

Astronaut / Cosmonaut Biographies
http://www.jsc.nasa.gov/Bios/index.html
The astronaut biography homepage provides information on the members of space flight crews and candidates for future missions in NASA's space flight programs.

NASAcast
http://www.nasa.gov/multimedia/podcasting/
Subscribe to NASA's omnibus podcast for the latest mission news, features and the "This Week @ NASA" report.

NASA Television
http://www.nasa.gov/multimedia/nasatv/
NASA TV is a resource designed to provide real-time coverage of NASA's activities and missions. NASA TV features ISS and Space Shuttle mission coverage, live special events, downlinks, electronic field trips, aviation and space news and historical NASA footage.

Science at NASA
http://science.nasa.gov
Find out the latest headline science news happening at NASA.

Section 3: The Technical Component

Understanding Amateur Radio Technology

How are ARISS contacts performed?
ARISS contacts can be performed in one of two ways, via a direct radio contact or a telebridge radio contact:

- A **DIRECT** radio link between an amateur radio station set up in your venue and the amateur station onboard the ISS. Direct contacts are timed such that the ISS is passing over your area.
- A **TELEBRIDGE**, where a dedicated ARISS amateur radio ground station, located somewhere in the world, establishes the radio link with the ISS. Voice communications between your students and the ground station are then patched over regular telephone lines.

Preparation is different for direct and telebridge contacts. For direct contacts, local amateur radio operators or clubs work with the host organization to set up antennas that provide a clear line of sight to the projected path of the space station. In a telebridge contact, a ground station somewhere in the world makes contact with the ISS and patches the host organization through via a telephone.

A **direct** contact will give your students an opportunity to use an amateur radio station at your location to speak with astronauts. It will also provide a first-hand opportunity to see an amateur radio station and learn how the radio system works. If you are planning on using your organization's amateur radio station, then it must meet certain technical requirements that are outlined in Section 3 of this planning guide. If you do not have a station, then you may be able to work with a local ham radio club to have them set-up and operate a portable station at your organization's location.

If you are unable to arrange a direct contact, a **telebridge** contact can also be a rewarding experience for students and faculty.

For either direct or telebridge contacts, your local amateur radio operators, your ARISS Technical Mentor and the ARRL's education resources can provide training with amateur radio operations and educational resources you can use to explore radio science and communications technologies with your students.

What technology do I need to have in place for a direct contact?
Local amateur radio operators or clubs can work with the host organization to set up the radios and antennas. The ARISS Technical Mentor is available to help the organization and the local amateur radio operators if they are unfamiliar with space communications.

For direct contacts, the antennas are installed to provide a clear line of sight to the projected path of the ISS. Typically this means the antennas are on the roof where the fewest obstructions are located. Because the ISS is 240 miles above Earth and going 17,500 miles per hour, it will cross the sky from horizon to horizon in about 10 minutes. During this time, the beam antennas must track horizontally (azimuth) and vertically (elevation). Due to the motion of the ISS, the radio frequency must also be corrected for the Doppler shift. By doing the Doppler shift correction, the audio clarity will be maintained as clearly as possible.

ARISS requires two complete radio stations at the event and redundant (preferably separate) power sources. Minimum station requirements for the primary station (radio station #1) are:

- Output power between 100-150 watts, receive pre-amp, OSCAR-style beam (Yagi) antenna, azimuth/elevation rotor control. Rotor with computer or manual control required. Manual control of frequencies using memory channels is preferred.

Minimum station requirements for the secondary station (radio station #2) are:

- Output power between 100-150 watts, receive pre-amp, omni-directional antenna (such as a vertical or "eggbeater" antenna).

Commercial and public domain software is available to help track when the ISS will be in range of your station, and where to point your antenna.

Most ARISS operations are split-frequency (schools use a different frequency for receiving the radio communication than is used for transmitting). The radio frequency you transmit on is called the ARISS Uplink Voice Frequency – you uplink your voices to the astronauts. The radio frequency you listen on is called the ARISS Downlink Voice Frequency – you are listening to the astronauts who downlink their voices to you. You will transmit on the uplink radio frequency only when the ISS is in range.

All ARISS contacts are assigned private uplink frequencies and public downlink frequencies. The use of private uplink frequencies is designed to reduce interference problems that may sporadically occur. The ARISS Voice Downlink Frequency is 145.80 MHz (Worldwide).

What technology do I need to have in place for a telebridge contact?
Two separate, dedicated telephone lines are required for telebridge contacts. The first telephone line serves as the direct communications line. The second telephone line (which can be a cell phone) serves as a backup in case there are any failures or technical issues with the first telephone line.

ARISS amateur radio telebridge ground stations enable ISS radio contacts with organizations that are unable to support a direct contact. This may be due to the ISS not passing over the school's location except during the night, or passing over at an elevation that is too low for a good radio contact, or other technical concerns. In a telebridge contact, one of the ARISS amateur radio telebridge ground stations around the world establishes the radio link with the crewmember using the ISS amateur radio station. Voice radio communications between students and the astronauts are patched over regular telephone lines to the amateur radio ground station and by radio to the ISS. About 2-3 weeks before a telebridge contact, an ARISS telebridge ground station will be named to assist your organization.

Can other people listen in on the contact?
Other schools, institutions, and amateurs can listen in on contacts. There is a standard downlink frequency for the events. If you happen to be in the footprint, you can hear portions of the ARISS contact. Listeners can only hear the crewmember answers, not the student questions. A list of the student questions is posted at http://www.rac.ca/ariss/upcoming.htm.

Section 4: The Media Component

What is a media/outreach/promotion plan?

A media/outreach/promotion plan is an overview of how the host organization plans to communicate information about the downlink and surrounding educational activities out to your community. The plan should describe plans for both internal and external promotion.