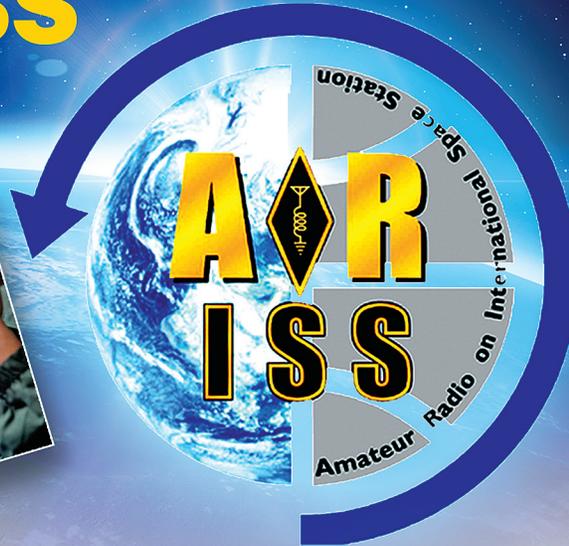
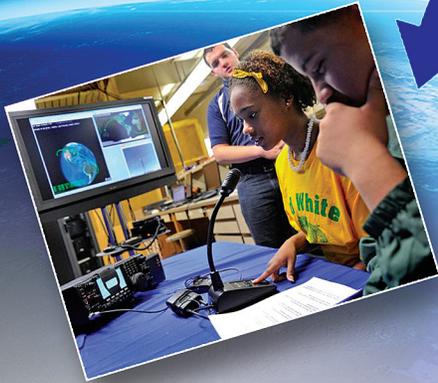


Amateur Radio on the International Space Station — **ARISS**



PROPOSAL GUIDE



ARRL The national association for
AMATEUR RADIO®

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Preface

Who Should Use This Guide

This Proposal Guide is for educators interested in hosting an Amateur Radio on the International Space Station (ARISS) contact in the United States and its territories. Before initiating a proposal please visit www.arrl.org/ARISS for a complete description of the program.

About ARISS

What is ARISS?

Amateur Radio on the International Space Station (ARISS) is a cooperative venture of the Radio Amateur Satellite Corporation (AMSAT), the American Radio Relay League (ARRL) and the National Aeronautics and Space Administration (NASA) in the United States, and other international space agencies and international amateur radio organizations around the world. The primary purpose of ARISS is to organize scheduled contacts via amateur radio between crewmembers aboard the International Space Station (ISS) and classrooms or informal education venues. With the help of experienced amateur radio volunteers from amateur radio clubs and coordination from the ARISS team, the ISS crewmembers speak directly with large group audiences in a variety of public forums such as school assemblies, science centers and museums, Scout camporees, jamborees and space camps, where students, teachers, parents, and communities learn about space, space technologies and Amateur Radio.

Goals of the ARISS program include:

- Inspire an interest in science, technology, engineering and math (STEM) subjects and in STEM careers among young people
- Provide an educational opportunity for students, teachers and the general public to learn about space exploration, space technologies and Amateur Radio as preparation for the event
- Provide an opportunity for amateur radio experimentation and evaluation of new technologies

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- Provide a contingency communications system for NASA and the ISS crew.
- Provide crew with another means to directly interact with a larger community outside the ISS, including friends and family.

ARISS United States Partners

NASA: NASA provides access to onboard ISS resources, including the on-board crewmembers, supports the launching of hardware, provides educational resources and supports mission planning for ARISS contacts.

AMSAT: AMSAT provides program leadership, technical support, and resource coordination (both US and international) to successfully conduct the ARISS program. AMSAT is responsible for the US development, operation and maintenance of the on-board hardware. AMSAT interacts with the national space agencies to provide expertise and guidance about amateur radio in space. AMSAT provides experienced volunteers who serve as ARISS Technical Mentors, guiding organizations through their technical execution of an ARISS contact.

ARRL: ARRL sponsors an educational outreach program that provides resources for students and teachers to explore radio science and wireless technology and to engage students in these and other STEM topics. ARRL also is part of the ARISS program leadership team, providing program guidance and administrative support. ARRL coordinates ARISS applications from US schools and organizations.

Read more about the international ARISS program partnership at:

www.ariss.org/about.html.

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

Though the ARISS contact itself is only a 10-minute event, the educational plan leading up to and following the event is much more extensive. Host organizations are expected to plan and execute an effective educational plan over a week, month, semester or school year that engages relevant content areas such as (but not limited to) space exploration, technologies related to space research, space communications and wireless technologies, and amateur radio as a hands-on learning focus. Educational plans focusing on this content will prepare students for a fuller appreciation of the ARISS contact event and can extend to further exploration of the space and radio/wireless technology topics following the actual event.

Why does NASA support 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 public to learn about wireless communications technologies and the capabilities of amateur radio, encouraging students to further explore these technologies.

This Proposal Guide offers information about the process and requirements to host an ARISS contact. You may direct questions or comments to ariss@arrl.org.

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, understanding the constraints of the planning timeline
- 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, including a partnership with representatives of your local ham radio community

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 as well as other educational organizations
- Attract widespread attention to your organization
- Support local education objectives and initiatives

Understanding the ARISS Proposal Process

What do I do first?

The first step is to decide if your organization is a good fit for this opportunity. Read this Proposal Guide thoroughly.

Then what?

If you decide you want to proceed, begin with a proposal containing your education plan. Proposal forms are available at www.arrl.org/hosting-an-ariss-contact. The ARISS proposal review committee will approve proposals that best meet the program's objectives. Because there are a limited number of contact opportunities, we must be selective. The criteria used to evaluate proposals are described in more detail in Section 2.

Proposals to host an ARISS contact are evaluated and decisions announced during two cycles each year to plan for contacts that will be scheduled 6-12 months into the future. Find the details for the current proposal window at www.arrl.org/hosting-an-ariss-contact.

The ARISS proposal process is a two-step process.

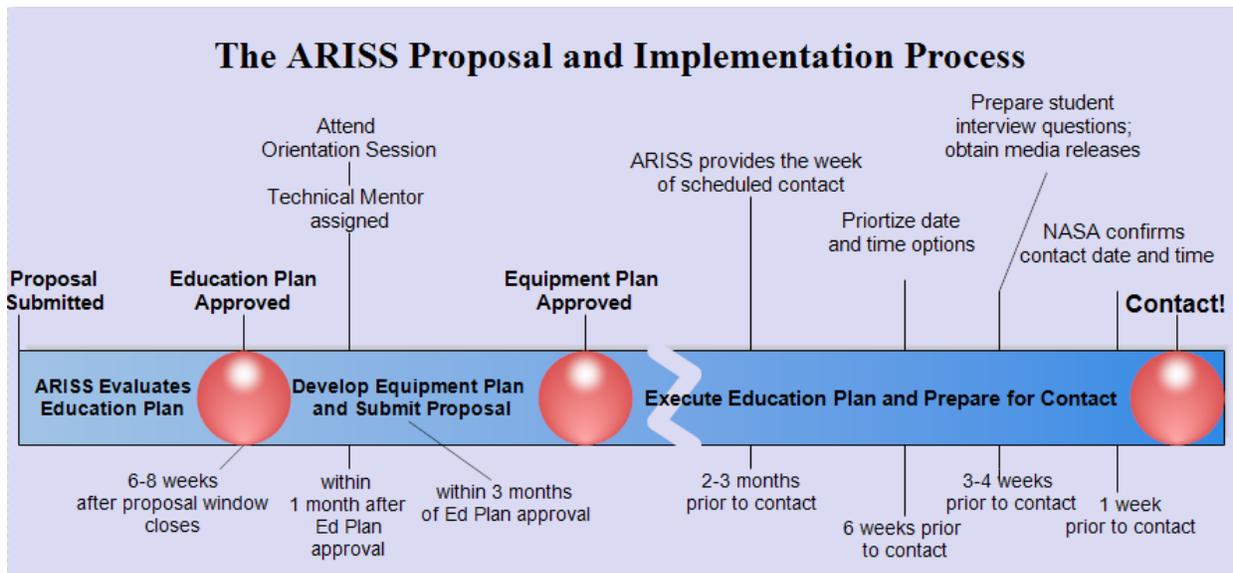
- Step 1 – Completion and approval of your Education Plan
- Step 2 – Completion and approval of your Equipment Plan

Details about the Education Plan and Equipment Plan appear later in this guide. After approval of both plans, your organization will be entered into the scheduling queue for an ARISS school contact. Bear in mind that your ability to execute your plan and also be available and flexible to respond to scheduling options provided by NASA for the radio contact are very important. Though we try very hard to provide scheduling options that align with your preferences, due to the nature of the program nothing can be guaranteed.

Once your Education Plan is approved (Step 1), an ARISS Technical Mentor will be assigned to work with your ARISS project team to help you develop your Equipment Plan (Step 2). The Technical Mentor is a volunteer amateur radio operator who is very experienced with satellite communications. He or she will help you and your local team of amateur radio operators develop a satisfactory Equipment Plan.

The Planning Timeline

The timeline and table below offer a broad outline of the major action and decision points in the preparation process for an ARISS contact. The Orientation Session and your Technical Mentor will provide details about specific activities and deliverables leading up to and after your contact.



Summary of Proposal and Implementation Process

Submit Education Proposal	
Education Plan is evaluated and approved	Within 6-8 weeks after proposal window closes
Attend Orientation Session; receive Technical Mentor assignment	Within 1 month after Education Plan approval
Determine direct or telebridge contact and submit Equipment Plan	As soon as possible, usually within 3 months after Education Plan is approved
Equipment Plan is approved; you are added to ARISS scheduling queue	
Implement Education Plan and prepare for contact	Within 1 month after Equipment

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	Plan is approved
Learn the week of the scheduled contact: Confirm availability	2-3 months prior to contact
Learn the possible dates and times during the assigned week of the contact: Prioritize options	6 weeks prior to contact
Prepare student interview questions and obtain media releases for participating students	3-4 weeks prior to contact
NASA confirms contact date and time	1 week prior to contact. <i>Note:</i> this short window is dictated by NASA operations planning and is beyond our control

Section 2: The Educational Component

Creating an ARISS Education Plan

What is an ARISS education plan?

An ARISS education plan describes how the host organization will utilize the ARISS contact to enrich STEM learning activities, support local education objectives and the goals of the ARISS program. The plan should describe how the pre- and post-contact activities 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 and/or National Educational Standards
- Use an interdisciplinary approach to lesson development
- Utilize cross-functional teaching teams
- Engage multiple grade level participation, the entire school, if possible
- Broadcast over school's LAN, CCTV or PA system and/ or Web
- Partner with local science-oriented organizations, such as museums, clubs, and industry

- Use year or semester-long space themes

What are some examples of classroom activities that can engage learning in preparation for the ARISS contact?

Here are some suggestions for classroom activities that can enrich the ARISS experience:

- Visit NASA web pages to find what research projects on the ISS the students find exciting
- Develop student projects related to a research project in the ISS National Lab
- Have students write a proposal for a research project they could like to conduct as an astronaut or a project for a space satellite
- Learn about other NASA space projects such as the Mars Lander Curiosity, Cassini, Voyager, the Hubble Telescope, the James Webb Space Telescope
- Research the biographies of astronauts
- Research the ISS communications systems
- Investigate the many uses of the radio spectrum and how it is managed
- Create posters about space
- Establish an amateur radio club
- Practice amateur radio operation protocols
- Broadcast a daily space fact over the PA system
- Explore careers related to space exploration and space technologies
- Learn about satellite orbits and orbital mechanics
- Build an antenna for satellite communications
- Involve students in the set up and operation of the ground station for the contact
- Find out when the ISS will orbit over your town and watch it pass overhead
- Invite guest speakers who work in science and technology fields
- Investigate radio science fundamentals
- Investigate electronics fundamentals

- Use satellite-tracking software to track orbits
- Write a story about life in space

The Addendum to this Guide provides references to educational resources you can utilize to build your Education Plan.

Elements of a Strong Education Plan

What are some tips to completing a strong education proposal?

- Brainstorm creative ways to maximize the ARISS contact reach and experience for students.
- Determine your educational objectives and plan a comprehensive educational program of which the ARISS contact is only one component.
- Incorporate partnerships that have a lasting impact on the community.
- Integrate NASA Education and amateur radio content with educational activities (links to a variety of NASA and ARRL resources are provided in the Addendum to this guide).
- Include an outline of the STEM activities and topics appropriate to the grade level of your students you will engage as part of the learning and preparation for the ISS contact.
- Describe how you will select the interview questions and students who will conduct the interview with the crewmember.
- Establish an evaluation plan that will help you determine whether you are accomplishing your objectives and the goals of the ARISS program.
- Keep date flexibility in mind. ARISS contact dates are driven by ISS mission requirements and are tentative due to the nature of human spaceflight.
- Proofread your proposal to make sure the information is complete and relevant.

The more advance preparation you make with educational plans, the more learning and value the ARISS event will have for students. Preference will be given to plans that

demonstrate careful thought and appropriate integration of STEM topics at student grade levels.

Evaluation of the Education Plan

Who will evaluate your plan?

Representatives from each of the US ARISS partners confer twice each year to review proposals submitted during the two proposal windows. Decisions on education proposals will be announced by email to the main point of contact who has submitted the proposal no later than 6-8 weeks following the close of the proposal window.

How will the education plan be evaluated?

Evaluation will weigh heavily on how well your proposal addresses the following questions:

- **Education**
 - How does the education plan support and build upon your school's/organization's curricular objectives?
 - Does the plan advance (enhance) the students' engagement in science, technology, engineering and mathematics (STEM)?
 - Does the education plan include STEM and amateur radio activities? Does it describe a number of hands-on activities?
 - Does the education plan include NASA resources and mission-related content?
 - Is the plan developed to extend over a period of time to increase and extend the impact of the ARISS contact for students in your audience?
 - Does the plan describe the student groups/grades that will be part of the education plan? What are the demographics of this group? What student groups/grades and other audiences will be part of the audience for the contact event?

- Have all educational organizations that are described as plan participants been involved in developing the plan and are they committed to carrying it out?
- **Logistics**
 - Does the proposal demonstrate flexibility should an ARISS radio contact shift dates and/or times?
 - 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 (audio/video/Internet and radio station)?
- **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?

Section 3: The Technical Component

Understanding Amateur Radio Technology

How are ARISS contacts performed?

An amateur radio contact with the space station is a line of sight contact between an amateur radio ground station and the amateur radio station on board the ISS. Your interview with the astronaut will utilize either a ground station at your location for a direct contact, or a ground station at another remote location for a telebridge 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 location.
- A **TELEBRIDGE**, in which an 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 travel over regular telephone lines.

Preparing for an Amateur Radio Contact

How do I prepare for an amateur radio contact?

Preparation is different for direct and telebridge contacts.

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. It will more clearly show the students the physics of spaceflight and orbits as the radio station will be tracking the position of the ISS with its antennas as the ISS flies overhead of your school. For direct contacts, local amateur radio operators or clubs work with the host organization to set up radio station equipment and antennas that provide a clear line of sight to the projected path of the space station.

If you are unable to arrange a direct contact, a **telebridge** contact can also be a rewarding experience for students and your community. 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 crew member using the ISS amateur radio station.

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.

It is important to reach out to your local ham radio community as you prepare your Education Plan. Discuss your educational objectives and your plan with them to determine their ability to support you with the expertise, equipment needs and instructional support for learning activities related to amateur radio. Get their commitment of support.

If you have trouble identifying a local ham radio club to support your efforts, contact the ARRL at ariss@arrl.org for assistance.

What equipment do I need to have in place for a direct contact?

Local amateur radio operators or clubs in your community can work with your organization to set up the necessary radios and antennas for a direct contact.

Briefly, for direct contacts, antennas are configured 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 traveling at 17,500 miles per hour, it will cross the sky from horizon to horizon in about 10 minutes. This path defines the communications footprint. 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.

The recommendations for the ground station to support a direct contact are considerably more robust than needed for a casual point to point radio contact. Because the scheduled contact is a one-time event involving a large audience, every effort is taken to configure a ground station that will offer the maximum communications window possible within the constraints of orbital mechanics and line of sight considerations, and to provide redundancy in the event of unexpected equipment failure.

If you are considering a direct contact, please review the current ARISS Ground Station Recommendations with your local amateur radio technical team. Find the current recommendations at www.arrl.org/hosting-an-ariss-contact.

What equipment 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. Discuss recommendations for a suitable telebridge configuration with your Technical Mentor.

Can other people listen in on the contact?

Other schools, institutions, and radio amateurs are encouraged to listen in on contacts. There is a standard downlink frequency for the events. If listeners happen to be in the ISS footprint, they can hear portions of the ARISS contact. Listeners can only hear the crew member answers, not the student questions, which are communicated on a separate frequency. The ARISS team shares the students' questions ahead of time so all listening in the ISS footprint or on the Web can follow along. Many host organizations stream the interview over the Web to make the entire interview available to students who are not on site for the event.

The Equipment Plan

What is involved with the Equipment Plan?

After your Education Plan has been approved, you must decide whether your contact will be executed direct, with a ground station on site, or by telebridge. You must develop an Equipment Plan that provides the information necessary to be sure you will be able to support the contact method you have chosen. Your Technical Mentor will assist you and your local ham radio team to help you work through the considerations. You will be expected to provide the information requested on the ARISS Equipment Plan Form. You

can download the form at www.arrl.org/hosting-an-ariss-contact. Your Equipment Plan must be completed and submitted as soon as possible after your Education Plan has been approved, usually within 3 months after approval. Your contact with the ISS will not be submitted for scheduling until your Equipment Plan is reviewed and accepted by the ARISS management team.

Section 4: The Media/Outreach 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 amateur radio interview and surrounding educational activities out to your community. The plan should describe plans for both internal and external promotion.

Some strategies to consider:

First promote within your school/organization!

What you are attempting to achieve is a program that will pull together all of the students, teachers, school staff, and much of your community in a single unified goal...a personal interview with a crew member on the ISS using amateur radio... that has stimulated students' interest in science, technology, math, and engineering (STEM).

It is very important to garner support from school administrators, principals, and superintendents. They can also offer services in obtaining media attention.

Parents

Remember to include parents and parent groups in your plans. Not only do they help encourage students to complete their part of the ARISS educational activities, but they can play a role in having the media see the importance of the event to the community.

Parents may be given the assignment of recording events (audio, video, note-taking, photographs) as they unfold. Parents can get quotes from students and teachers about

the learning activities leading up to the ARISS contact and the impact on their outlook. Enlist the help of parents and their students in distributing programs for the ARISS contact day, and in seating VIPs and the media.

Business Leaders and Community VIPs

Business leaders and local VIPs can offer help in a variety of ways. For some it might mean offers of various media exposure, printing of invitations, t-shirts for students, or simply demonstrating support for the students. Create and distribute special invitations to local VIPs.

Other Schools and Educational Groups

Invite neighboring schools to listen in to the radio contact from a remote location. Even better, invite them to attend your educational activities and ARISS contact. Provide a special seating area for them.

Involve Students

- Students can be selected to write articles describing their learning activities for the school paper, local paper, and other media.
- Create programs to be distributed on the day of the event to all who attend. These become great keepsakes. They can also help to communicate some details about the event.
- Work with students so that they will be prepared to speak to the media after the radio contact. Prior practice doing this can be helpful for students.
- Select students for specific responsibilities such as publicity, art work, production of event programs and invitations.
- Select students for the responsibility of recording all of the school's activities and lessons, including the day of the contact.

How do we involve local news media?

You will want to make sure that you inform your local news organizations about your upcoming interview with the ISS. You will need to notify them in advance about the planned event and keep them informed as you have more details about the date and time the contact will occur. It is important to designate someone within your organization as the point of contact with media to make sure that accurate and timely information is provided. You might consider inviting the media to tour your school before the ARISS contact to see what students have been learning. Be sure to emphasize the educational impact of the opportunity.

- Send news releases to newspapers, TV stations, radio stations once the date of the contact is known. Get a sample press release at www.arrl.org/hosting-an-ariss-contact and customize it for your venue.
- Ensure you have collected the required ARISS release forms from all students who will be participating in the ARISS contact who will be interviewed, recorded, or photographed by the media. When at all possible, obtain these releases in advance of the planned day of the contact. Scan and send the releases to your Technical Mentor and to ariss@arrl.org in advance of the contact so photos can be released immediately to NASA and ARISS communication channels. You'll find an ARISS release form you can download and print at www.arrl.org/hosting-an-ariss-contact.
- Send photos and video of students engaged with educational activities related to the ARISS event and of activities and the interview on the day of the event to ariss@arrl.org. We will need signed release forms for any students featured in the photos or videos in order to use them in our publications or communications.
- Send links for newspaper articles, television stories and other website stories to your ARISS Technical Mentor so we can communicate the story about your event to the organizations that fund ARISS.

Addendum: Resources for Education

Accessing NASA Resources

What kinds of NASA educational resources are available from NASA?

NASA produces a variety of resources for educators and students. These 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. DLN also has a special ARISS Module at www.nasa.gov/offices/education/programs/national/dln/events/HAM_It_Up.html for those interested in learning more about the ARISS program.

[Space Place](#)

<http://spaceplace.nasa.gov/>

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NASA and partners Jet Propulsion Laboratory, California Institute of Technology, ITEEA (International Technology and Engineering Education Association) have developed this website with activities and resources for elementary students and educators. For an overview of the site's content and suggestions for its use:

<http://spaceplace.nasa.gov/review/about-us/faq.html>

[NEON \(NASA Educators Online Network\)](#)

<http://neon.intronetworks.com/#>

Subscribe to this newsletter for information about opportunities resources and professional development opportunities.

[International Space Station \(ISS\) Home Page](#)

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.

[NASA Space Communication and Navigation \(SCaN\) Home Page](#)

http://www.nasa.gov/directorates/heo/scan/#.VCwZ5T_AbaJ

This site serves as the main homepage for SCaN, the NASA organization responsible for NASA's communications with satellites, including ISS.

[Space Station Explorers](#)

<http://spacestationexplorers.org/>

This site is for educational programs sponsored by CASIS (Center for Advancement of Science in Space).

[Space Operations Learning Center](#)

<http://solc.gsfc.nasa.gov/>

This site is a web-based educational environment designed to provide a safe, fun and educational environment that allows students of all ages to learn various topics about NASA and space through multimedia tools and hands-on simulations. The main training modules contain topics for students in grades 5 through 12. The KIDS ZONE area is geared for those students in kindergarten through 4th grade. The modules support several national and state standards for science and technology across all grade levels

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.

[Astronaut Appearance Requests](#)

<http://www.nasa.gov/about/speakers/astronautappearances.html#.VCsBhvldUnc>

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 and 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/#.VCsBgfldUnc>

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, amateur radio contacts, 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. Subscribe to *NASA Science News*, an electronic newsletter, to learn about new findings and developments in space research. This is a great way to get students tuned in to space research activities.

[Visions of the Future](#)

<http://www.jpl.nasa.gov/visions-of-the-future/>

Find posters available to print from Jet Propulsion Laboratory.

Accessing ARRL Education Resources

What kinds of resources are available from ARRL?

ARRL's Education & Technology Program offers three types of resources to teachers and schools. These 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 help their students understand how an amateur radio contact with the ISS is conducted. 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 *expenses paid* professional development opportunities each summer that provide hands-on training for educators to learn about basic electronics, wireless communications, micro-controllers, programming fundamentals and robotics and offers resources for classroom instruction. Attending the Teachers Institute is a great way to prepare for an ISS contact through the ARISS program.

Listen to or Watch ARISS Contacts

<http://www.ariss.org/news.html> or <http://www.arrl.org/listen-to-watch-ariss-contacts>

These web pages provide 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. A search on YouTube will produce additional video recordings of ARISS contacts.

[Preparation for an ARISS Contact](#)

<http://www.arrl.org/preparation-for-an-ariss-contact>

Resources collected on this web page will generate ideas for your education plan. You'll find resources here for learning about satellite communications, radio science, electronics and space travel and exploration and some sample education plans developed by other schools.

[Using Amateur Radio in the Classroom](#)

<http://www.arrl.org/amateur-radio-in-the-classroom>

This web page provides information on using amateur radio in the classroom as an effective way to teach both fact and theory. Amateur radio can be used to engage students in a variety of subjects. Visit the web page at www.arrl.org/curriculum-connections-and-benchmarks for ideas about how amateur radio subject content can align with state and national learning objectives.