



# Radio Waves

News you can use for license instruction and radio science education

ARRL — The national association for AMATEUR RADIO

Spring 2014

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## Cool for Class

Teachers are always looking for good tools to help them connect with students. Pat Moore, AL7L, of the Juneau ARC hopes to add a new digital one. Moore says, "We have one father-son team who live on a remote Southeast Alaska island taking the course 'by correspondence.' We're looking into a way to Skype them in to the sessions."

## "Hands-On" Class Is Hands-Down Hit for Juneau Amateur Radio Club

BY PAT MOORE, AL7L



Co-instructor Sam Binkley, AL7V (standing) interprets a schematic as (left to right, seated) Craig Smith, KL3JN, Dave Carnes, NL7UM, and Ron Hagerup, WL7ZN, prepare to assemble a non-inverting op-amp circuit. (Photo by Pat Moore, AL7L)

Inspired by Ward Silver's (NØAX) *Hands-On Radio* series, the Juneau (Alaska) ARC and I recently offered a practical radio course to help Technicians upgrade their licenses.

Armed with copies of *Hands-On Radio, Hands-On Radio, Volume 2* (at a discount through the ARRL) and two Hands-On Radio Parts Kits (ARRL #1255K), I was ready for the experiments outlined in the books. I dusted off my old plug-in prototyping board, put together lesson ideas, and signed up interested members at a club meeting.

At our first class we dove right in, sorting parts into a pair of Husky 18-drawer parts cabinets, giving some students their first experience with resistor color coding and handling components. Next, we set up my prototyping board and began constructing a

common-emitter amplifier. We hooked up the scope and a pair of voltmeters and soon had scope traces of amplification on the screen.

By the second class, students were showing up with their own magnifiers, cheat sheets for color codes, meters, and tools! By the third class, we formed two teams to work on the experiments.

We've since taken up a collection and bought some circuit boards and coil stock to begin construction of the 40-meter oscillator and amplifier described in *Hands-On Radio*. We hope to put the rigs on the air for a few contacts when we're done. Look for KL7JRC (the club call sign) on 40-meter CW.

Pat Moore, AL7L, has been teaching licensing classes since 1960.

## Licensing Classes and Learning Activities

### Webinars Bring It Home for Club's Licensing Drive

Radio Waves recently touched base with Long Island Mobile Amateur Radio Club's (LIMARC's) education chairman, Joe Gomez, W2BMP. We asked Joe about his experiences teaching a licensing course via webinar for the club.

Success rate? So far, LIMARC is batting 1000! —Ed.

**RW:** How/why did you and LIMARC decide to offer instruction in this format?

**JG:** Being a computer engineer, I was very familiar with webinar-type technology and virtual meetings. While LIMARC is a big club, with one of the best repeater systems around, we have no permanent home. It became clear that traditional educational classes would be impossible due to the limited availability of our meeting hall. With mounting requests for continuing education, I put two and two together and decided to use the web-based format to run licensing classes and other workshops.

**RW:** Does class preparation differ from traditional teaching formats?

**JG:** Initially it does take a little more time to prepare the material you will share on your computer, and to get the slides together, but after a few times you figure out what works and what doesn't. There's a great deal of resources on the web that we use to review material, and we all take the practice exams together. We share our tips for studying. Because there are no time constraints we can adjust the lesson plans for each group as needed.

**RW:** What kinds of demos do you conduct via webcam?

**JG:** Since I have several rigs at my desk, I demo everything — from how a squelch works to working satellites.

**RW:** Approximately how many students have you/LIMARC taught this way to date?

**JG:** In the last 18 months, I have taught more than 300 students using this method. We are approaching 40

students so far in the LIMARC program in just three months, over three class types.

**RW:** What is the typical mix of students like? Do you think offering webinars has affected the mix in any way?

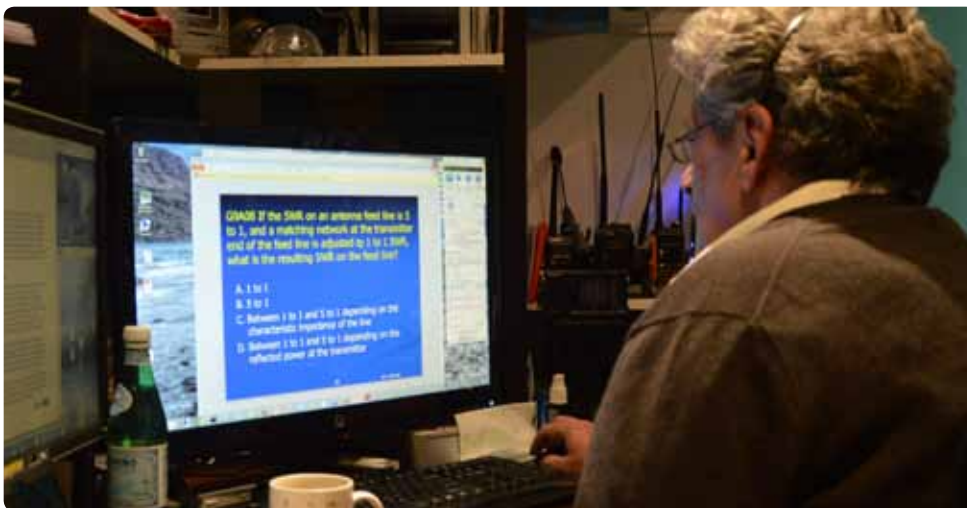
**JG:** The mix is incredible! I routinely have people in their teens as well as in their 80s. Because we don't actually see what each other looks like during the class, it works great. I have had medical doctors in the same class as 14 year olds. I have also seen a lot of women signing up.

**RW:** What kind of feedback do you receive from students?

**JG:** We have started to take surveys just recently where the students rate the 12 different aspects of the class. Six of these questions deal with learning via this format versus in a traditional classroom setting. So far we have a 98.5% rating. The students enjoyed this format as much as, or more than, a traditional classroom setting or self-study program.

**RW:** Can you address the success rate of this approach versus a traditional class?

**JG:** The LIMARC program is enjoying a 100% first-time success rate. Although a few students may leave the class, as many — if not more — join the class in progress over the first week or so, so we usually end up with close to our maximum of 25 students per class. The goal is to keep up the 100% pass rate.



Joe Gomez, W2BMP, LIMARC's education chairman, conducts a license class webinar. (Photo by Paul Gomez, KD2CYQ)

## Update on Recent ARISS Activities

The Amateur Radio on the International Space Station (ARISS) program has seen a lot of activity lately, with many scheduled interviews between U.S. students and astronauts coming off successfully (see below). For more contacts, event details and links to audio/video files, visit [www.ariss.org/news.html](http://www.ariss.org/news.html).

A direct contact between students at **Hidden Oaks Middle School**, Prior Lake, MN, and astronaut Koichi Wakata, KC5ZTA, was successful on May 1 at 16:28:17 UTC.

Students at **Dixon Elementary School**, Holly Ridge, NC, made contact via NC4OC with astronaut Wakata on April 21 at 18:05:53 UTC.

Astronaut Wakata also spoke with students at **Forest Knolls Elementary School** (see photo), Silver Spring, MD, via the school's Amateur Radio station, KB3WOA, on March 20 14:38:33 UTC. Astronaut Wakata answered 20 questions for students.

On March 14, students at **Warren Consolidated Schools**, Warren, MI, used W8HP for a successful contact at 11:24:58 UTC with Astronaut Wakata, who answered 24 questions posed by the students.

Students at **Rock Bridge Elementary School**, Columbia, MO, enjoyed a direct contact with astronaut Mike Hopkins, KF5LJG, via KMØR on March 5 at 14:00:13 UTC.

On February 28 at 18:04 UTC, students at **Exploration Place**, Wichita, KS, were successful on their second attempt at making direct contact with the ISS via WØSOE.

A telebridge contact between students at **Delaware Township School**, Sergeantsville, NJ, and Astronaut Wakata was successful, via VK4KHZ, on February 19 at 15:04:25 UTC.

Marymount University hosted students at **Fort Belvoir Elementary School**, Arlington, VA, for a telebridge contact between NA1SS and K6DUE on February 19 at 19:02:07 UTC in Greenbelt, MD. Astronaut Wakata answered 23 questions.

Another telebridge contact was made, via station K6DUE, between students at **Wallingford STEM Academy**/Wallingford, CT, and Astronaut Wakata on January 18.

For information about upcoming ARISS contacts, visit [www.ariss.org/upcoming-contacts.html](http://www.ariss.org/upcoming-contacts.html).



Kelvin Aleman, a fifth-grade student at Forest Knolls Elementary School, asks a question of astronaut Koichi Wakata, KC5ZTA. Kelvin is flanked by first grade teacher Melissa Happ, KB3VEX (left), and student Maritza Ortiz (right), also in the fifth grade. (Photo courtesy of KB3WOA)



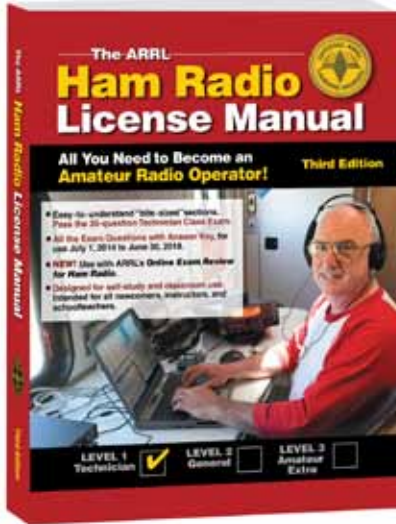
### An ARISS Opportunity

Contact Debra Johnson, K1DMJ, ARRL ARISS Program Manager, at [djohnson@arrl.org](mailto:djohnson@arrl.org), if your school, local museum or other educational organization is interested in participating in a scheduled ARISS contact in the Spring 2015 time period. An educational plan describing the learning activities that will be provided for students leading up to and following the contact is necessary for consideration. To learn more about the ARISS program visit [www.arrl.org/amateur-radio-on-the-international-space-station](http://www.arrl.org/amateur-radio-on-the-international-space-station).



## Instructor Corner — News, Ideas, Support

### New ARRL Technician Study and Instruction Materials



The new edition of *The ARRL Ham Radio License Manual* is now available in our store. It addresses the changes for FCC exams effective July 1, 2014.

The ARRL has just released the third edition of *The ARRL Ham Radio License Manual*, which addresses the changes in the FCC question pool that will be effective for license exams conducted from July 1, 2014, through June 30, 2018.

In addition, ARRL is offering a browser-based online application that allows students to prepare for the exam by reviewing questions organized in sync with the content discussion in our study manual. This application also offers the flexibility to review in question pool sub-element order and provides sample exams with the option to print them out. Learn more at [www.arrl.org/news/view/arrl-announces-free-exam-review-website](http://www.arrl.org/news/view/arrl-announces-free-exam-review-website).

ARRL has also developed new materials for instruction of the Technician license content that coordinate with the presentation of topics in the new, third edition of *The ARRL Ham Radio License Manual*, addressing the entire FCC question pool. These materials are assembled as a new sixth edition of our *Instructor's Manual for Technician License Courses*, including lesson plans, PowerPoint slides, suggestions for instructional activities and demonstrations.

The new *Instructor's Manual* is posted online at [www.arrl.org/arrl-technician-instructor-manual](http://www.arrl.org/arrl-technician-instructor-manual) and is available as a FREE download to ARRL-registered instructors.

## Improved ARRL Instructor Resource Page

In our ongoing effort to support teachers of Amateur Radio, this area of the ARRL website has been refreshed and reorganized. We continue to add resources that are shared by instructors for use by the educator community. Recent additions include:

- The latest revision of Pete Kemp's (KZ1Z) *Teachers' Guide to Amateur Radio Instruction*.
- A set of PowerPoint slides developed by Mike Sanders, N1QLN, George Carbonell, N1RME, and Chuck

Motes, K1DFS, of the Charter Oak Radio Society for instruction of the General license content that is synchronized to follow the presentation of material in *The ARRL General Class License Manual*.

- Shared materials developed by Rick Crockett, WØPC, for instruction of the Amateur Extra class license material.

Learn more about what's available online at [www.arrl.org/resources-for-license-instruction](http://www.arrl.org/resources-for-license-instruction).



St. Charles Amateur Radio Club conducts a class at St. Charles Community College. Instructors (from left to right) are John Lohnhoff, NØHMZ, Gordon Denno, AH6DA, Ken Humbertson, WØKAH, Rick Crockett, WØPC, Jay Underdown, WØPS, Bob Perrey, ADØGF. Not in photo, Jim Richardson, N5MU. (Photo by Helen Crockett, ACØNF)

## Improved ARRL Instructor Resource Page (cont.)

Another new addition to our Instructor Resources is to be found in our “Graduation Kit.” It’s a flyer that includes a special offer of a free copy of *Getting Started with Ham Radio*, by ARRL author Steve Ford, WB8IMY, with a new ARRL membership. The four-color flyer has a special band chart of Technician Class Amateur Radio privileges on the reverse side for easy reference.

Check it out in the Instructor Resource section of the ARRL website. Ordering instructions for the Graduation Kit are provided there.



## Instruction Junction: Resistance Made Easy

To find the single equivalent resistance for more than two resistors in parallel, use the product-over-sum formula to combine resistors gradually in sets of two, instead of in one large reciprocal-of-sum-of-reciprocal formula.

Here is the product-over-sum formula for two parallel resistors, R1 and R2:  $Req = (R1 \times R2) / (R1 + R2)$

Start by combining any two of the resistors into a single equivalent resistance using the formula above. Then combine the resulting equivalent resistance with any single remaining resistor into a new equivalent resistance. Repeat the process of combining the equivalent resistance with a single resistor until all resistances have been combined into a single equivalent resistance.

**Example** — Find the equivalent resistance for four parallel resistors: R1 = 100  $\Omega$ , R2 = 200  $\Omega$ , R3 = 50  $\Omega$ , R4 = 25  $\Omega$

**Step 1** - combine R1 and R2:  $Req = (100 \times 200) / (100 + 200) = 66.7 \Omega$

**Step 2** - combine 66.7  $\Omega$  with R3:  $Req = (66.7 \times 50) / (66.7 + 50) = 28.6 \Omega$

**Step 3** - combine 28.6  $\Omega$  with R4:  $Req = (28.6 \times 25) / (28.6 + 25) = 13.3 \Omega$

This process can be applied to any number of resistors in parallel and also works for inductors in parallel and capacitors in series. (Thanks to Allen Wolff, KC7O)

If you have resources that you find helpful, or a strategy or tip that you find successful, please send them to us! Send your ideas to Debra Johnson, K1DMJ, ARRL Education Services Manager, at [djohnson@arrl.org](mailto:djohnson@arrl.org).

## In The Classroom



Olde Towne Middle School students and staff send a weather balloon aloft. It reached 62,000 feet. (Photo by Vincent Webb, N5WXW)

# Amateur Radio Ballooning Adventures

BY BILL RICHARDSON, N5VEI

On March 11, 2014, students and staff of Olde Towne Middle School in Ridgeland, MS, launched a near-space balloon with the hopes of taking science experiments to at least 90,000 feet. Students from the Radio and Technology Club joined others from the Science Club to participate in the launch. At 10:10 am the balloon was sent aloft from the school grounds, observed by honor roll students, the mayor, and city board and other members of the community. Once it was launched, Amateur Radio operators started tracking and chasing the balloon. Unfortunately, it only reached 62,000 feet before bursting.

The balloon was on a fast pace both skyward and back down to Earth. Science teacher Bobby Robinson, ham vol-

unteers Rez Johnson, K1REZ, McLeod Johnson, W5JMJ, Robert Errington, KF5IZ, a group of students, and I were in hot pursuit all the way to Scott County. APRS (Automatic Packet Reporting System) got us within a few hundred yards, but the outlook was not good. A SPOT locator beacon put the exact location in the middle of a swamp  $\frac{1}{3}$  of a mile off the main road. While the straight-line distance was short, the journey was over a mile long through waist-high creeks, deep mud, bamboo groves, and some of the worst terrain in the area. Rez and McLeod were the first to find the payload. It took a total of three trips into the swamp over two days to recover the entire payload (see sidebar).

Unfortunately, some of the experiments were a loss due to the recovery

stress (the payload was found nearly 100 feet high, in the tops of several trees). A complete analysis will be conducted in the near future by the science department. Overall, the balloon project was a success, and we plan to launch another next spring.

*Bill Richardson, N5VEI, has taught middle and high school for 14 years and holds an Amateur Extra class license.*

### Balloon Payload

- Battery test
- Biological test with yeast (cellular respiration)
- Air expansion test
- Chem trail swipe (looking for particulate)
- "Crickonaut" survivability
- Seed exposure to low atmospheric and low temperature as well as cosmic radiation
- Micrometeor collection via magnetic field generation
- Evaporation test

Also collected cosmic radiation samples via film exposure.

A video of the Olde Towne Middle School balloon launch can be found [here](#).

Olde Towne Middle School has received several grants from ARRL's Education & Technology Program, most recently a research buoy outfitted with electronic sensors and ham radio transceiver to transmit data. Richardson is a graduate of ARRL's Teachers Institute and will assist with instruction of the TI-2 on Remote Sensing and Data Gathering this summer.



*“From the moment the doors opened, we had visitors to our booth.”*

—Martha Muir, W4MSA



For more ideas about making an outreach event successful, see Martha Muir’s (W4MSA) “Amateur Radio Creates Buzz at Atlanta Science Expo” at [www.arrl.org/recruiting-outreach](http://www.arrl.org/recruiting-outreach).

## Outreach: Beyond Hamfests . . .

Amateur Radio wowed the crowd at the Atlanta Science Festival Exploration Expo, the grand finale of a weeklong celebration of STEM (Science, Technology, Electronics, and Math) activities.

The event, held on March 29 at the Georgia World Congress Center in downtown Atlanta, drew more than 16,000 scientifically curious attendees.

The Georgia Section of the ARRL — with support from HamJam, a cooperative between the SouthEastern DX Club and the North Fulton Amateur Radio League (NFARC) — hosted a booth at the Expo. A main focus of the exhibit was to show teachers how they could use Amateur Radio and related electronics in the classroom to enrich the STEM curriculum.

“From the moment the doors opened, we had visitors to our booth,” said Martha Muir, W4MSA, Section Youth Coordinator. “Some were quite



The Amateur Radio booth at the Atlanta Science Festival Exploration Expo hummed with activity all day. (Photo by Martha Muir, W4MSA)

young, some at the other end of the age spectrum, with many in between.”

Visitors stopping by could trace their voices on an oscilloscope, see a Tesla coil in action, watch a video of an ARISS radio contact, track satellites, and spell their names out in Morse code. Muir and others were on hand to offer information on supplementing classroom activities with Amateur Radio and how to get a license.

## . . . And Outside the Classroom

Since 1999, Joel Colman, NO5FD, has been introducing Amateur Radio to youngsters at the URJ (Union for Reform Judaism) Henry S. Jacobs Camp in its residential summer program in Utica, MS.

Colman meets with campers who choose the radio elective for one hour, three to four times a week. While he says it’s not enough time to offer a licensing course, it does allow Colman to teach them about Morse code, the phonetic alphabet, making QSOs, and even a little contesting. “They won’t come away from the course knowing Morse code,” says Colman, “but they

will have learned about our hobby and the fun it can offer.”

This summer Colman hopes to introduce portable Amateur Radio using digital modes. “I want to be able to set up somewhere in camp during free time in the early evening [when] the bands open up a bit in the summer, and it becomes much easier to make a QSO,” he says.

Colman shares some specific techniques he’s developed to introduce various aspects of Amateur Radio at the summer camp. They’re posted as a resource for other instructors at [www.arrl.org/outreach-to-youth](http://www.arrl.org/outreach-to-youth).



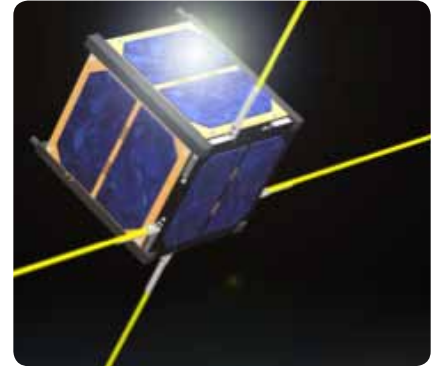
Joel Colman, NO5FD, with children attending the URJ Henry S. Jacobs Camp, Utica, MS. Happy campers all!

## CubeSat Investigators: What's Going On with FUNCube?

“The FUNCube (AO-73) satellite is an excellent resource that allows your students to be real space sleuths and hone their forensics skills by investigating what is happening to the satellite in orbit...just like the TV crime scene investigators do in popular crime solving shows,” says Mark Spencer, WA8SME, ARRL Education & Technology Program Consultant. This satellite “just keeps on giving and is full of surprises,” he says.

Spencer has been following FUNCube since its launch last November. The data he is receiving is generating some provoking questions. Read more at [www.arrl.org/csi-space](http://www.arrl.org/csi-space).

Information on bringing space into the classroom can be found at [www.arrl.org/classroom-library-satellite-communications](http://www.arrl.org/classroom-library-satellite-communications).



The FUNCube (AO-73) is a powerful teaching tool for the classroom. Visit the ARRL website to learn more.

## Education & Technology Program News

### Teachers Institute TI-1 Program Going Strong

ARRL has received a progress report from Hamlin Middle School in Springfield, OR, about its experience with the Teachers Institute TI-1 program. According to Hamlin science and math teacher Nelson Farrier, KF7EON, “... we’re in our third year of doing our ‘no solder, code oscillator’ project with another 200 middle school students. We’ve also been doing an after-school electronics and robotics program this year using the Parallax Boe-Bots that has been successful in getting several students interested in programming and electronics.”

### 2014 Teachers Institute Sessions Filled

We’ve accepted 34 teachers to participate in ARRL’s **Teachers Institute on Wireless Technology** this summer. This year’s participants come from 20 states and instruct in grades 5 through 16. We offer this professional development opportunity to teachers who are just getting started with radio science and electronics, as well as to those who are more experienced but looking for new teaching strategies and ways to integrate wireless technology content in their curriculum. Unfortunately, we again had to turn away many applicants due to lack of space.



Curious about how  
Amateur Radio can  
connect to classroom  
curriculum?

Devon Day, KF6KEE, from  
McBride High School in  
Long Beach, CA, has shared  
her map of connections  
to California Department  
of Education Content  
Standards. Check it out at  
[www.arrl.org/curriculum-connections-and-benchmarks](http://www.arrl.org/curriculum-connections-and-benchmarks).



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Resources for License Instructors:

[www.arrl.org/resources-for-license-instruction](http://www.arrl.org/resources-for-license-instruction)

Resources for Teachers:

[www.arrl.org/amateur-radio-in-the-classroom](http://www.arrl.org/amateur-radio-in-the-classroom)

Education & Technology Program:

[www.arrl.org/education-technology-program](http://www.arrl.org/education-technology-program)

Teachers Institute on Wireless Technology:

[www.arrl.org/teachers-institute-on-wireless-technology](http://www.arrl.org/teachers-institute-on-wireless-technology)

ARISS Program:

[www.arrl.org/amateur-radio-on-the-international-space-station](http://www.arrl.org/amateur-radio-on-the-international-space-station)

## 2014 Licensing Statistics

The following report of FCC licenses issued is supplied by Maria Somma, AB1FM, ARRL VEC Manager. Somma notes that license activity levels for the first quarter of 2014 are up. New licensees increased by an incredible 16% over the same period in 2013 (8,943 in 2014 versus 7,732 in 2013). Upgraded licenses were up by 13% over 2013 (2,719 in 2014 versus 2,414 in 2013).

NEW AND UPGRADED FCC LICENSES ISSUED PER YEAR BY QUARTER				
FCC License Activity	2011	2012	2013	2014
	First Quarter	First Quarter	First Quarter	First Quarter
Technician	5,077	6,654	6,850	7,950
General	2,527	2,728	2,507	2,810
Extra	861	974	789	902
<b>Total Issued</b>	<b>8,465</b>	<b>10,356</b>	<b>10,146</b>	<b>11,662</b>

## 2014 Upcoming Events, Opportunities and Deadlines

**School Station Equipment and Progress Grant** applications are due in to the Education & Technology Program November 1. Information and applications can be found at [www.arrl.org/etp-grants](http://www.arrl.org/etp-grants).

**Fall Radio Operating Events** — Start planning now for these upcoming challenges:

- Jamboree on the Air (JOTA): October 17 – 19, 2014 ([www.arrl.org/jamboree-on-the-air-jota](http://www.arrl.org/jamboree-on-the-air-jota))
- School Club Roundup: October 20 – 24, 2014 ([www.arrl.org/school-club-roundup](http://www.arrl.org/school-club-roundup))

**The ARRL Foundation Scholarships** application period opens October 1. Get more information at [www.arrl.org/scholarship-program](http://www.arrl.org/scholarship-program).

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