Radio Waves

News you can use for license instruction and radio science education

ARRL — The national association for AMATEUR RADIO

Fall 2016

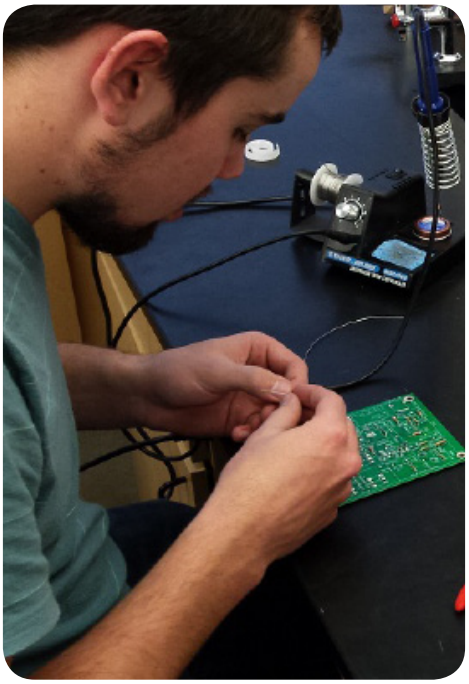
INSIDE THIS ISSUE:

Don't Miss...

An outreach to outdoors enthusiasts was a real winner for the Fresno Area Mentor and Elmer (FAME) license class recruiting effort of the Clovis Amateur Radio Pioneers (Central California). Greg Waters, KJ6OUI, provides the surprising details in his article, "FAME in Fresno — A Success Story in Recruiting New Hams," in the September 2016 issue of *QST*. ARRL members can access the article online **here**.

Building Blocks Illustrate Basics Electronics

BY RON CALL, N7GOA



Madison High School student assembles a 5 Building Blocks Activity Board. (Photo by Ron Call, N7GOA)

Seven years ago, I started a professional technical electronics program at Madison High School, a rural school in Rexburg, Idaho, that serves aproximately 1,000 students in grades 10 – 12. Students in the program can take electronics all year long for three years. Usually, sophomores take Beginning Electronics, juniors Intermediate Electronics, and seniors Advanced Electronics.

In my intermediate classes, I use a tool called the 5 Building Blocks Activity Board. Created by former ARRL Education & Technology Program Coordinator Mark Spencer, WA8SME, the "5BB" boards are ideal for teaching wireless technology.

The 5BB boards cover the five basic building blocks of wireless technology (oscillators, rectifiers, amplifiers, mixers, and filters). I divide my students into teams, and they solder the components onto the boards. They then use digital oscilloscopes to analyze the signals and explore concepts of modulation and demodulation. After using the 5BB boards, several students built their own amplifiers and rectifiers. Best of all, two of my intermediate electronics students obtained their ham radio licenses this year, and more are interested in becoming licensed next year.

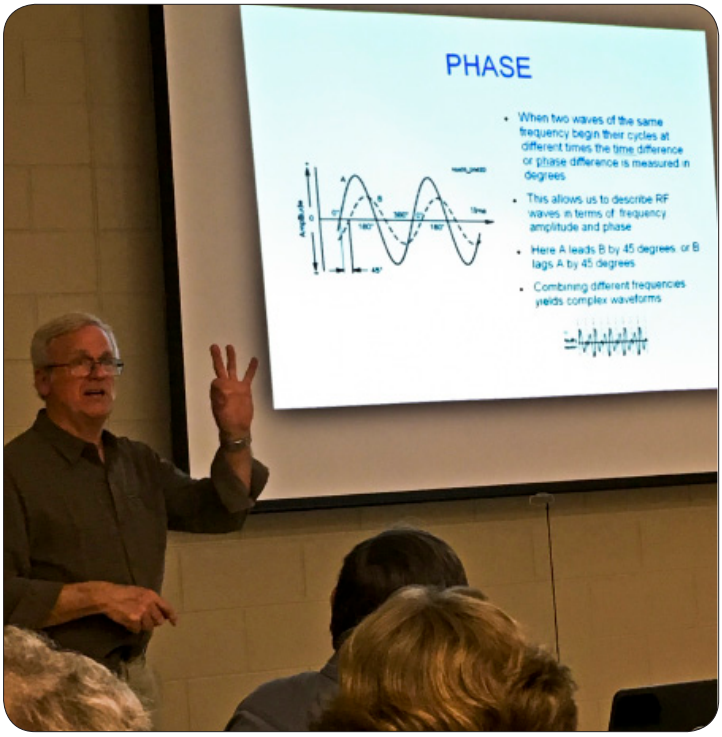
Because the boards work so well and are so popular with my students, ARRL sent me more boards this year. One student had this to say about working with the 5BB board: "It has helped me learn how to understand the various parts of the radio circuit, particularly mixers and how they combine different signals."

Editor's Note: For more information on the 5 Building Blocks Activity Board, point your web browser ***here****.*

Ron Call, N7GOA, teaches a three-year electronics program at Madison High School, Rexburg, ID. He holds an Amateur Extra class license.

The Easton Amateur Radio Society Technical Institute

BY DR. JACK GOTTSCHALK, K8PBJ



Dr. Jack Gottschalk, K8PBJ, presenting Transmission Lines & Matching Networks. (Photo by Kenny Thomas, KA3DCO)

The roster of Maryland's Easton Amateur Radio Society (EARS) represents the wide diversity found within Amateur Radio. Some of our members have held a license since the 1950s and are extremely experienced; others have just recently passed an exam and are enthusiastic, hungry to learn, and sometimes overwhelmed by the scope and complexity of the hobby. To help enrich their experience by introducing, or "reintroducing," them to the technical aspects of Amateur Radio, EARS, which celebrates its 50th anniversary this year, developed a Technical Institute for the benefit of all our members.

We began by giving members a self-scoring quiz of fairly basic Electronic/RF concepts to generate interest and let everyone test their knowledge. We then formed a committee, formalized the concept of a Technical Institute, and started the design work. First, using the subject indexes of The ARRL's *Handbook*, *Operating Manual*, and *Understanding Basic Electronics*, as well as a few other related resources, we created the framework for our curriculum. We then selected a mix of topics, ranging from basic theory to practical matters like proper station grounding and using an antenna analyzer. We made our selections based on the perceived interest of our members, technical complexity, and the ability of our potential instructors to effectively teach the subject.

The topics targeted for Year One of the Institute, and presented to the members for review prior to program launch, included the following: Quality Factors of Inductors and Capacitors; Capacitors & Alternating Current/Sine Waves; Inductors at RF; Proper Grounding of an Amateur Radio Station; Using an Antenna Analyzer; and Understanding Antennas & Wavelength.

Our programs were initially designed as 10-minute presentations, followed by 10-minute discussion periods, though we've found it can be difficult sticking to this schedule for some topics. Designing an interesting and informative presentation, especially with hands-on demonstrations, requires considerable effort. Instructors usually have to develop each presentation months ahead of time.

Using our 2-meter weekly net, instructors provide members with a brief overview of the forthcoming topic. This is done to generate interest, to give members time to assess their current understanding of the subject, and to allow for study two weeks before the program is conducted. We've found that adults generally prefer to be informed about a subject before it is presented.

So far, the feedback from our members has been very positive. Typical comments include, "Learned a lot," "Realized how much I've forgotten," "A good review," "Over my head somewhat but I learned a lot," "I've got to go back to the Handbook to study," and "Keep it coming." The Technical Institute Committee plans to reconvene in mid-summer to evaluate Year One and to set the curriculum for Year Two.

Dr. Jack Gottschalk, K8PBJ, is President of the Easton Amateur Radio Society. He has been licensed as a radio amateur since 1959 and enjoys operating and maintaining vintage gear. He may be reached at ***K8PBJ@yahoo.com****.*

Ham Radio Flies High at Summer Camp at Kopernik Observatory

BY DREW DESKUR, KA1M

This past summer, the Kopernik Observatory & Science Center in Vestal, New York, offered a wide range of week-long, STEM-based camps, two of which prominently featured Amateur Radio.

Balloon and Payload Pays Off

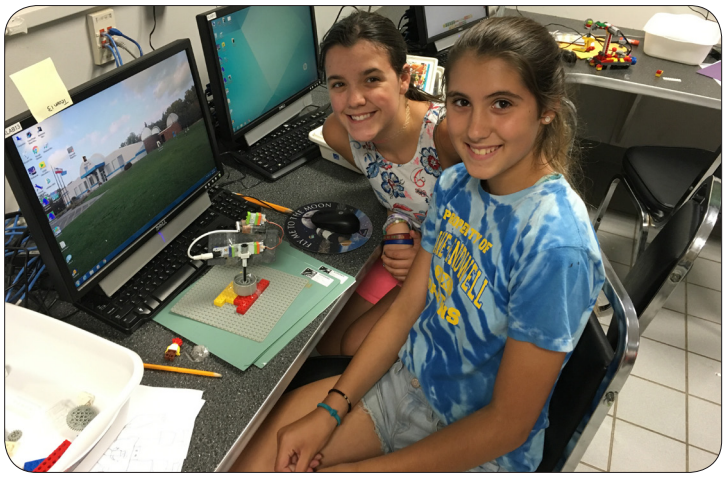
One camp, "Journey to the Edge of Space," was offered to middle school students, with their project being to design, build, test, and launch a payload on a weather balloon. Along with three GoPro HERO cameras and a temperature monitoring system, the payload included a 2-meter APRS beacon that reported, in real time, the payload longitude, latitude, and altitude throughout the duration of the flight. The students learned about Amateur Radio and how the APRS network operated to report the balloon's flightpath. The APRS beacon was critical in the recovery of the payload. After recovering the payload and collecting the video, they learned how to interpret the raw packets from the beacon and used that information to measure ascent (and decent) rate and map the information into a 3-D model of the flightpath on *Google Earth*. They were impressed to see that at the max altitude of over 105,000 feet (nearly 20 miles), the station reporting the packet was a digipeater near Ottawa, Canada — nearly 250 miles away.

ARISS Contact Brings Lab to Life

A second camp, "Robots on the ISS," offered fourth and fifth graders an exciting opportunity to learn about various aspects of robot hardware and software design and function. Their "lab" was the International Space Station and, working in teams, they designed robots that might be able to help astronauts on the ISS to do their jobs. What better way to design a project than to speak directly with the people who might use their designs, in this case an astronaut on the ISS? Kopernik was able to secure an Amateur Radio on the International Space Station (ARISS) contact during the camp. While the ISS was in range, 18 students were able to ask astronaut Colonel Jeff Williams about how robots are used on the ISS and about work and life there. In addition to rehearsing for the contact, portions of the camp week were dedicated to explaining radio communication, satellite tracking, and Amateur Radio.

As shown on the YouTube video of the contact, Col. Williams answered back on the first call, and the students had great success getting their questions answered. The video of the ARISS contact is available **here**.

Drew Deskur, KA1M, is the director of the Kopernik Observatory & Science Center, and a Life Member of ARRL and AMSAT.



Students designed and built robots at Kopernik's "Robots on the ISS" summer camp. (Photo by Kasia Mazur, Kopernik staff)

Students line up to ask their questions about robots used on the International Space Station. (Photo by Kasia Mazur, Kopernik staff)

Update on Recent ARISS Activities

Amateur Radio on the International Space Station (ARISS) program saw many successes this summer and fall, with many more young people communicating directly with astronauts (see below). To learn more about ARISS, including how your school or organization can apply for contact consideration, visit www.arrl.org/amateur-radio-on-the-international-space-station.

A telebridge contact via VK5ZAI with students at **Stephen F. Austin Elementary School, Brazosport ISD, Jones Creek, TX**, was successful Monday, October 10, 2016.

A telebridge contact via IK1SLD with students at **iSPACE, Cincinnati, OH**, was successful Saturday, October 8, 2016.

A contact with students and scouts at **Lewis and Clark National Historic Park, Astoria, OR,** was successful Saturday, September 10, 2016.

Students and scouts at Lewis and Clark National Historic Park, Astoria, OR.

A direct contact via KCØNFL with students at **Lawrence Public Library, Lawrence, KS**, was successful Friday, September 9, 2016.

ARISS contact at Lawrence Public Library, Lawrence, KS.

A direct contact via N9DR with students at **The Children's Museum of Indianapolis, Indianapolis IN**, was successful Tuesday, August 23, 2016.

A direct contact via K2ZRO with students attending a summer engineering camp at **Kopernik Observatory & Science Center, Vestal, NY** (see related feature elsewhere in this issue), was successful Thursday, August 18, 2016.

For information about upcoming ARISS contacts, visit ***www.ariss.org/upcoming-contacts.html.***

A Year of ARISS Outreach

The World Genesis Foundation, a 501c3 not-for-profit organization dedicated to the mission to "leave no child without hope for the future," will host an ARISS contact this fall for students from multiple schools in rural districts of La Paz County, Arizona. It will be the culmination of a nearly year-long effort that has served as a focal point for regional educational outreach.

Learning activities kicked off on January 13, 2016, with "Radio Science Day," which brought students from six schools together at the community center in the town of Quartzsite for a hands-on experience in Amateur Radio and radio science. More than 250 youth and 30 volunteers participated in the full-day event highlighted by eight indoor and outdoor stations with 20 interactive exhibits.

Additionally, as part of the ARISS educational plan, and to ensure new learning opportunities beyond the ARISS contact, the Arizona Amateur Radio Association (AZARA) was launched. La Paz educator and AZARA president, Dave Anderson, K1AN, says the youth-led project has already helped 15 young people from three towns obtain their Amateur Radio licenses. "Our expectation is that the AZARA program will bring at least 50 youth from 12 towns into Amateur Radio and connect them on a single new regional Amateur Radio network," says Anderson. "They will be connected to each other via Amateur Radio well before many of them have Internet access in their towns and homes."

For more information, see www.AZARA.org.

ARISS Application Closing Soon

The current window for ARISS proposals for contacts to be scheduled July – December, 2017, will close on November 1, 2016. The next proposal window will open in February 2017. For information on applying, visit www.arrl.org/hosting-an-ariss-contact, or contact Debra Johnson, K1DMJ, ARRL ARISS Program Manager, at djohnson@arrl.org.

Outreach

Alumnus a Golden Resource

Inspired by a visit to his college preparatory institution for his 50th reunion, Dick Hayman, WN3R, really "paid it back" to the Bullis School in Potomac, Maryland. Hayman, a 1963 graduate, had helped start an Amateur Radio club while he was a student there, and he returned to volunteer his skills and expertise over five decades later as an alumni sponsor for the Bullis' robotics club, RC^2 (for Robotics, Communications, and Computers). Because of the radio control aspect of their robotics studies — and the high degree of enthusiam — the students put a school station, K3BSB, back on the air.

The Bullis station and radio club are briefly on hiatus due to lack of space, but a nearly 70,000-square-foot STEM building is under construction, which will be able to house an impressive "shack." Watch a nicely produced video of the students setting up for their first contact at **www.youtube.com/watch?v=NXhoU_oZ2-o**.

Operators work the original Amateur Radio station, K3QVH, at the Bullis School, circa 1964.

Get on the Air Event Gets Busy

Faith Hannah Lea, AE4FH (right), operating the GOTA station with an unidentified student (left) at Old Dominion University. (Photo by Keith Howell, KE4KDY)

The K4AMG Memorial Amateur Radio Club was recently invited by the Batton College of Engineering and Technology at Old Dominion University (Norfolk, Virginia) to host an Amateur Radio Get on the Air (GOTA) station and to give presentations demonstrating STEM concepts to over 400 visiting middle and high school students.

A highlight of the setup, which included a transceiver purchased with funds from an ARRL grant, was the portable all-mode OSCAR (Orbiting Satellite Carrying Amateur Radio) station, with a computer and programs controlling the Amateur Radio transceiver and rotors. Operators offered demonstrations of HF and OSCAR communications as well as a CubeSat simulator, providing a great example of mechatronics, a multidisciplinary field of science combining electronics, computer engineering, and telecommunications, among others.

Boy Scouts Man Up for Youth Operated Station

Eight Boy Scouts were on hand to staff the Youth Operated Station (YOS) at RARSfest, the Raleigh (NC) Amateur Radio Society hamfest held in April 2016. Under adult control operator supervision, the Scouts served as the core of the team at the YOS and worked VHF (repeater), HF-SSB and HF-Digital modes. The successful outreach was part of RARS's ongoing effort to draw Scouts into Amateur Radio.

The goals of the YOS were to get the Scouts on the air as a group and to demonstrate Scout/youth interest in the hobby. While at the RARSfest, all the Scouts got on the radio, some took part in making a portable J-pole antenna, one took a license exam, and all enjoyed the day. RARS is now also setting its sights on a Girl Scouts outreach effort.

Instructor Corner — News, Ideas, Support

ARRL Launches Instructor Recognition Program

The ARRL has always valued the efforts that Amateur Radio volunteers make on behalf of the instruction classes that prepare students for the exams they must take for their first Amateur Radio license or an upgraded license. Over the years, we've regularly recognized the contributions of Volunteer Examiners who conduct exam sessions, and now we are putting in place a program that will allow us to also recognize the efforts of Volunteer Instructors.

Because exam sessions must be reported to the FCC, we've long had a structure that enables us to collect data about the activities of VEs, but have had no method of systematically capturing the activities of instructors. No more! We're now introducing a web-based program for ARRL Registered Instructors to provide us with information about their classes and instruction activities. This will also give us a way to recognize the important contributions that instructors make to Amateur Radio.

Additionally, the new program allows instructors to print a certificate verifying their status as ARRL Registered Instructors, and it will also provide certificates to acknowledge milestones.

For this program to be effective, instructors will be asked to provide feedback about their classes using our web-based information system. You'll find more details about how this will work on the ARRL website at **www.arrl.org/instructor-feedback**. We've also published a YouTube tutorial, which you'll find at **https://youtu.be/Yq7OWkvtrQc**, to provide you with an introductory tour.

Don't be surprised when you receive an email request to complete a feedback survey at the conclusion of your next class! We hope you'll respond promptly.

Resources for Instruction

Instructors and teachers looking for projects to explore radio in the classroom or with scouting and outreach activities may find these resources on crystal radios useful:

- "How a Crystal Radio Works" video posted **here**
- "Simple DIY Crystal Radio — How to Build" video posted **here**
- "How to Make a Crystal Radio" video posted **here**

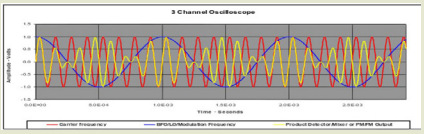
SparkFun introduced a new temperature, humidity, and air pressure sensor that's great for environmental studies. You'll find more information **here**.

Cool Tool

Frequency on Display

Radio Amateur Richard Gillette, W9PE, offers this interesting post in the Yahoo group, "Richard F. Gillette P.E." (it's in response to the comment, "I am looking for ideas on how to effectively demonstrate frequency mixing in a classroom setting"):

> When teaching, I solved the display issue by writing an Excel program that has two frequency and amplitude adjustable signal generators, a multiplier/mixer/product detector or a phase modulator, a three-channel oscilloscope, and a spectrum analyzer.
>
> The signal generators clip at 2 V peak-to-peak to allow adjustable distortion through square waves. One generator has an on-off DC offset of plus 1 V, allowing amplitude modulation. When set to the same frequency, the generators are quadrature-phase locked. The phase modulator has a fully adjustable modulation index to control deviation. The scope displays the time domain, and the spectrum analyzer displays the frequency domain of the mixer's output signal or the phase/frequency modulation.
>
> Take a look at my website, **www.w9pe.us**, for more info and how to get the program instructions (with a list of setups that apply to hams teaching). The instructions provide the link to download the program.



Education & Technology Program News

Summer 2016 Teacher Institutes Generate Excitement

ARRL offered three sessions of the introductory Teachers Institute (TI-1) this past summer in Colorado, California, and Connecticut. Thirty-five teachers from 17 states participated. This year, the TI-1 was expanded from four days of training to five in order to provide more time for discussions on classroom implementation, demonstrations of classroom activities, and absorbtion of the concepts covered. The session in Colorado, hosted by Douglas County STEM School and Academy, was funded by a local donor.

The class got high marks from participants. "My background is in architecture and construction, so electronics has never been a strength for me," said Lance Newman, a high school teacher from Illinois. "Although I teach some basics in communications technology and modern manufacturing processes, I have struggled to bring hands-on, practical applications to my students. TI-1 was just what I needed!" Newman said he's planning to get his Amateur Radio license and is excited about bringing ham radio into his classrooms.

Plans for summer sessions in 2017 are underway. The schedule will be announced in February 2017. Information will be posted on the ARRL website at **www.arrl.org/ti**.

A traditional "fox hunt" is part of the TI curriculum. (Photo by Larry Kendall, K6NDL)

You can support the Teachers Institute with a donation to the Education & Technology Program Fund. Consider funding a seat for a teacher to attend the TI! Find out more at **www.arrl.org/education-and-technology-fund**.

Recent Licensing Statistics

The following report of FCC licenses issued is supplied by Maria Somma, AB1FM, ARRL VEC Manager. Somma notes that 2016 licenses issued through the third quarter are up 5% from 2015's totals and are approaching 2014's record-setting pace. If this trend continues, we should see 32,000 new Amateurs and 11,000 upgrades by the end of this year!

Here's the breakdown of exam activity through the third quarter by license level:

NEW and UPGRADED FCC LICENSES ISSUED PER YEAR BY QUARTER						
FCC License Activity	2011 3rd quarter	2012 3rd quarter	2013 3rd quarter	2014 3rd quarter	2015 3rd quarter	2016 3rd quarter
Technician	15,974	18,132	19,195	22,781	20,526	22,170
General	7,742	7,994	7,372	8,401	8,572	8,105
Extra	2,827	2,564	2,326	2,913	2,914	3,474
Total Issued	26,543	28,690	28,893	34,095	32,012	33,749

Contact Us:

ARRL Education Services
225 Main Street
Newington, CT 06111

Debra Johnson, K1DMJ
Education Services Manager
Radio Waves Editor
(860) 594-0296
djohnson@arrl.org

Edith Lennon, N2ZRW
Radio Waves Contributing Editor

Visit Us:

Resources for License Instructors:
www.arrl.org/resources-for-license-instruction

Resources for Teachers:
www.arrl.org/amateur-radio-in-the-classroom

Education & Technology Program:
www.arrl.org/education-technology-program

Teachers Institute on Wireless Technology:
www.arrl.org/teachers-institute-on-wireless-technology

ARISS Program:
www.arrl.org/amateur-radio-on-the-international-space-station

Access *Radio Waves*

Find this and other issues of *Radio Waves* in interactive online format at www.arrl.org/radio-waves

Announcements, Upcoming Events, Opportunities, and Deadlines

ARISS Proposal Window Now Open — The ARISS Program's proposal window for accepting submissions from educational organizations seeking to host scheduled contacts with the ISS between July – December 2017 is open until **November 1, 2016**. Details and opportunities to participate in Information Sessions will be posted at www.arrl.org/hosting-an-ariss-contact.

Education & Technology Program (ETP) Grant — Application deadline for this ARRL education support program is **November 1, 2016**. Two types of grants are offered: ETP School Station Grants and ETP Progress Grants. Find out more about the program and the application process at www.arrl.org/etp-grants.

ARRL Foundation Scholarship — More than 80 scholarships will be awarded to eligible radio amateurs who are pursuing higher education. Application deadline for 2017 scholarships is **January 31, 2017**. For information and application forms, visit www.arrl.org/scholarship-program.

Thinking Day on the Air (TDOTA), February 26, 2017 — It's not too early to begin planning for Thinking Day on the Air, held the third weekend of February. Find more information at www.arrl.org/amateur-radio-and-scouting.

Herb S. Brier Instructor of the Year Award — The deadline for nominations for this year's Herb S. Brier Award is **March 15, 2017**. Visit www.arrl.org/herb-s-brier-award for details. Please note that the documentation that must accompany a nomination may take some preparation time.

You are subscribed to receive the ARRL Instructor/Teacher E-Letter. If you have an ARRL website user account, you can manage all of your e-mail preferences at www.arrl.org/myarrl. If not, contact us at ead@arrl.org to subscribe/unsubscribe.

ARRL The national association for AMATEUR RADIO®
225 MAIN STREET • NEWINGTON, CT USA 06111
(860) 594-0200 • WWW.ARRL.ORG