

RADIO WAVES

News you can use for license instruction
and radio science education

2025 - Issue 4



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Cover photo: Two students work together to build a tape measure antenna at the Staten Island Technical High School Amateur Radio League clubroom (WS1THS). Read more in the Teacher Spotlight!

Teacher Spotlight: Everton Henriques, KD2ZZT

Interviewed by Eliza Croarkin, KC1TAP
Submitted 2025

Ham radio is a multifaceted hobby. Which aspects of ham radio were most interesting to you, both personally and professionally?

The idea of using amateur radio to facilitate telemetry for our solar car team was my original draw. My personal and professional interests overlap, in that I enjoy fabrication and using those items that I create to complete tasks. For example, designing rudimentary antennas is something interesting that my students can do, and they can use these devices to foxhunt or make tailored communications. Radio offers a great introduction to how basic physics can be applied to wireless systems that we not only enjoy, but rely on in daily life.

How did your learning in TI-1 and TI-2 impact your teaching and school as a whole?

The most notable impact of TI for me was making efficient sense of amateur radio concepts that apply directly to the classroom. Additionally, professional experience and “tried-and-true” teaching methods were shared, allowing me to bring productive hands-on learning back to the classroom instantly. As an example, I attempted to learn about foxhunting and tried my own hand at it soon after earning my Technician-class license. I was able to find a reasonable amount of success after many days. Fast-forward to TI-1, and I was able to learn how to effectively foxhunt using a variety of



Everton Henriques (KD2ZZT) teaches grades 9–12 at Staten Island Technical High School. He also runs the Staten Island Technical High School Amateur Radio League (WS1THS) after school and had attended the ARRL TI-1 in 2023 and TI-2 in 2024.

techniques and — more importantly — how to actually teach students to do it in ONE DAY. Couple this with the fact that I was able to level up to the Amateur Extra class during that TI session, and you can see that just a small percentage of the training produces exponential results. The TI program connected me with some generous grant opportunities that allowed me to outfit my classroom with a Geochron system and official multiband radio station, making it much more interesting and accessible to my students, with immediate effect.

You run the Staten Island Technical High School Amateur Radio League (SITHS ARL) (WS1THS) after school. Can you tell us about some of the most exciting activities and projects your current students have been working on this academic year?

Exciting and noteworthy activities really depend on the lens of the observer. From the ham community's perspective, the most impressive and exciting aspect of our club and program is our dedicated approach to getting large numbers of students familiar with radio basics and licensed. We licensed 268 students since the spring of 2023, with 28 students earning their General-class license and 10 leveling up to Amateur Extra. Students are often excited by the ability to design and fabricate working antennas that can be used for foxhunting. Everyone LOVES foxhunting! Visiting students and parents are always impressed by the fabrication aspects of the course and watching current students operate the WS1THS station's HF radio. One club member made a long-distance 20m contact with a ham in Wisconsin during our last Open House event, and it generated considerable interest in our school. Visiting teachers and administrators are most impressed by how we promote radio applications through hands-on projects to address basic physics concepts like circuits and waves, design skill development in areas of 3D printing, soldering, hardware, construction, electronic terminals, and soft skills in communication.

“Everyone wants to be the important person holding a radio... When you engage in radio, you not only see people doing that, you ARE doing... all of that.”

- Everton Henriques

What is the best way for teachers to get their students interested in amateur radio and wireless technology? What do you think draws high schoolers into the hobby and the school club?

I see 2 different approaches to getting students involved. I recall interning at IBM when I was 19 years old, and I thought that the clean room suit made the workers look so high-tech. I was so excited to be able to wear one and felt so special, even though my personal responsibilities were not nearly as high as the engineers that I worked with. Amateur radio has the same appeal. Everyone wants to be the important person holding a radio, operating an earpiece, soldering high-tech electronics, crimping neat-looking electrical terminals, speaking the phonetic alphabet like a special forces operator, having an official government-issued call sign, searching for rogue transmitters, etc. When you engage in radio, you not only see people doing that, you ARE doing/being all of that. Students need to see the real deal in action to fire their excitement, and not the limited stereotype seen on the screen of a doomsday movie.

Another approach is to simply introduce (push) radio concepts in everyday STEM and humanities curricula. Most kids don't want to eat their vegetables, but they certainly will when someone seasons them just right and they see the benefit to their body. From the use of radio and Morse code in war, current communications,



The ARRL Teachers Institute (TI-1) session held at Staten Island Technical High School this January. Everton Henriques, KD2ZZT, and Wayne Greene, KB4DSF, are pictured at the right end.

maker movements, physics, and robotics/electronics, there is always an application that is real across all subjects, and there is a benefit to a student's hands-on toolbox. I can use myself as an example of this: I heard of radio, but I didn't really know of or do anything with it beyond use a walkie-talkie despite being a STEM teacher for well over 10 years at that point. I was forced to look into it for a particular need, and now I have incorporated it as both a hobby and in all that I do academically. The hobby will sell itself, but just like vegetables, which need to be seasoned and cooked properly, it sometimes takes a force-feeding to realize that you love them! Consider Life at Terminal Velocity with Carlos, KD9OLN, who combines ham radio and jumping out of airplanes in what is arguably the coolest and most adrenaline-pumping hobby out there. That dude is amazing, seasons his ham radio just right, and continues to be an effective promoter of the hobby to students!

An impressive 268 students have become licensed thanks to this program! Is

there a preferred way to study for the exam at SITHS ARL? How have your students used their licenses after passing their FCC exam?

Some students find that the ARRL books explain the details that they need to feel comfortable. Others prefer to jump straight to the test pool. All of them utilize hamstudy.org to explore the question pool and check up on their aptitude. That website, plus the great resources on the Ham Radio Crash Course YouTube channel, offer great and accessible explanations of the test concepts, and Josh Nass, K16NAZ, is a gold standard and familiar face in the ham education world. Students have found great success with Ham Radio Prep as well.

There is a lot of great content out there, and to best facilitate student understanding, we take the approach of making our end purely hands-on or gamified. No kid gets excited about SWR when first exploring amateur radio. Instead, we need to incorporate more of a lab setting, where

students can take existing or DIY antennas of different sizes and compare their performance when using different frequencies. Ham Jeopardy is always a hit as well. We are fortunate to have a great cohort of educators involved in the ARRL Learning Center, where a ton of great lessons and experiences are compiled to boost our classrooms.

After getting their licenses, the big focus is for students to learn HOW to operate their radios. Just like a student with a hammer, we need to make sure that they can pick out WHEN to use the hammer and be able to do so effectively. Swinging a hammer is not enough. Students first focus on net activity — both as a participant and net control — and repeater activity. Both provide ample opportunities to practice making contacts, and we embed a strong element of manual programming to best understand the basic principles of frequency, CTCSS, articulation, and all related elements of appropriate and efficient contact. Students move on to designing and building various antennas to

be used for foxhunting, satellite contacts, and their future introduction to the world of HF. Tuning in to emergency school communications, or even organizing communications for our Open House, robotics, and related club events is a must, and their training gets them fully ready for it. Aside from those mandatory items previously listed, students have the option of going further with HF, digital modes, and SDR at their leisure.

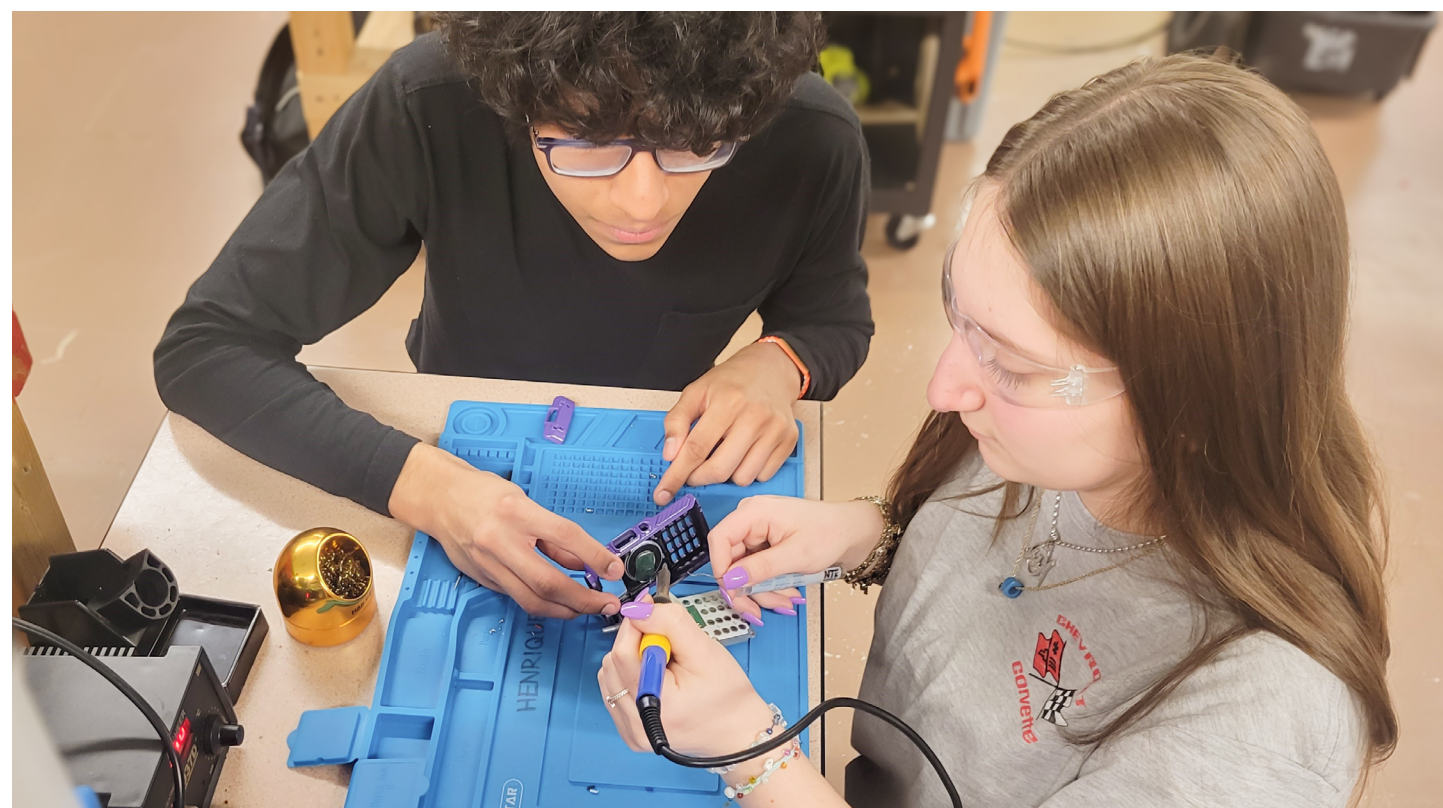
You were asked to serve as a co-teacher with ARRL's Wayne Greene (KB4DSF) at the latest TI-1 session in January 2025. As you worked with fellow teachers, was there a benefit to having previously been a student in this program?

There absolutely was a benefit. Every time I attend a class, conference, or general hangout with Wayne, I learn a ton of new things. I was much less of a co-teacher and more of a student in this round! I think the benefit of being a former participant is that I have a little bit of expe-

rience with the areas of the training that might be more difficult, and I also have more knowledge of how the concepts translate to students in the classroom. But honestly, the biggest benefit was the extra knowledge that I was able to pick up in Wayne's newest iteration of the course.

We both know how beneficial radio can be for hands-on, student-centered learning across grade levels. Are there any challenges you have experienced or can foresee about bringing radio into the classroom?

I am finding that the biggest challenge is managing overly proactive students, especially with larger student numbers, as they tend to make “mistakes” that are not favored by the ham community and/or the FCC. I firmly believe that radio naturally works and will create the appropriate “reaction” in any setting, but, like in chemistry, you sometimes need a catalyst to get things started. Sometimes you just have to force the issue with the knowledge that the future benefits will come. A lack of teacher training or fear of the seemingly unknown will be a huge issue, but TI is doing a great job of fixing that! Going back to those students who like to “make mistakes,” forcing a student who is not interested may lead to them abusing the new knowledge and “responsibilities” that they otherwise may not have engaged in. I make sure my students know that they need to follow school policy, which includes following all local laws, so their actions on the air have school-based impacts, and a teacher will certainly need some form of administrative buy-in to address these issues.



Ham Radio Has a Place in a Homeschool Program

Written by Wayne Greene, KB4DSF
Submitted 2025

We have seen the success of STEM programs in public, private, and after-school programs; however, home school groups, cooperations, and associations can be a perfect environment for STEM and radio science programs. I am a home school educator for our home school association. I teach middle school and high school history and STEM. I even combine history with STEM at times. I also run an afterschool STEM program that is wireless technology focused.

One benefit of teaching in a home school environment is the freedom to write our own curriculum. An example is one that I wrote that combines world history with STEM — specifically, the telegraph. The history lessons begin in 1746 with a look at Jean-Antoine Nollet's experiment, whereby he discharged several Leyden jars across an iron wire that was held by approximately 200 monks. He noticed each monk reacted at the same time the Leyden jars were discharged, thus determining that electricity traveled nearly instantaneously. The vehicle we use to move from one historical period, event, or person is the development of the telegraph. Throughout the school year, we learn about important historical events, such as the American Revolution, the French Revolution, and the Pony Express. We also learn the telegraph network was rife with scams and fraud that are very similar to those we encounter on the internet today. Other interesting facts we learn include the development of the pneumatic tube network, which was developed because the popularity

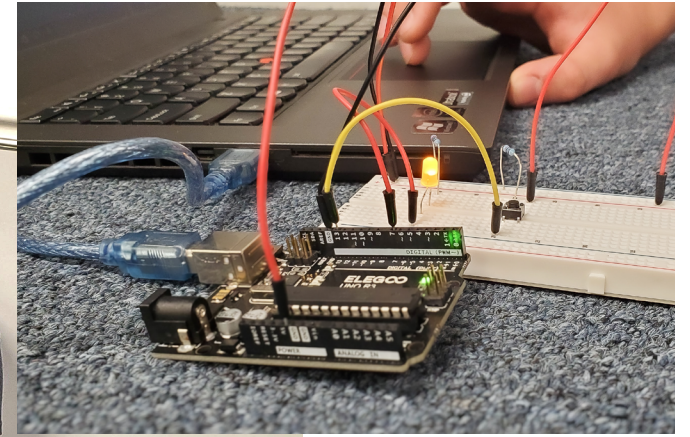
of the telegraph network caused it to get overwhelmed.

I do run microcontroller-based STEM classes as well. These classes start with building simple electronic circuits without the aid of a microcontroller while I help the kids learn basic electronic principles. We then add the microcontrollers to expand our electronics projects. My favorite moments are watching students work through problem-solving scenarios — especially troubleshooting situations. I may be asked for help, but I tend to allow the student to figure things out on their own. The sense of joy that comes across their face when they solve the problem is priceless, and they realize they can do hard things.

My radio and wireless technology-focused after-school programs include foxhunts, APRS



Andrea Sando getting on the air with an HT.



projects, simplex communications, and satellites. I have run several successful licensing classes and have helped kids with license upgrades. We are in the process of launching a youth amateur radio club as well.

If you are in a home school environment and may be interested in starting a STEM program in your home school group or as an after-school program, please reach out to me. I would be very happy to help you get started. Please email me at wgreene@arrl.org.

Corey Evans built a circuit consisting of a push button and an LED, each inserted in different Arduino pins. He wrote an Arduino sketch that turned the LED on when the Arduino pin sensed a digital high (1) indicating when the push button has been pressed, and off when the push button is released



Alexa Carbo and her classmates design code for a breadboard in a homeschool class.

Best Kept Secret: Learning Core Content Through Amateur Radio!

Written by Kay Orr, K5ORR
Submitted 2025

Amateur radio offers a timeless way to connect with others, contribute to communities through emergency communications, learn technical skills, and provide a platform for connecting academic learning to real-world experiences. Our school district found a great way to introduce young people to this unique hobby through collaboration between local schools and amateur radio clubs. Engineering teacher Leslie Reese (KI-5ISS) and Instructional Technology Specialist Kay Orr (K5ORR) from Rockwall



Learning about HF radio and making contacts from Mike Williamson, N5MAW; Doug Smith, WB5WRC, and Erik Oistad, KF6DZT. Radios were acquired through an ARRL grant.

ISD (Texas) attended the ARRL Teachers Institute on Wireless Technology and became aware of the many ways amateur radio can benefit students from elementary through high school with direct ties to the academic curriculum.

Our district Instructional Technology Team is hosting four nights this school year, showcasing STEM-related clubs/activities at our Dr. Gene Burton College and Career Academy. These events target students and families throughout the district in grades K–8. Events are supported by middle and high school student volunteers. One of these recent nights focused on Amateur Radio and our newly formed high school club

(KJ5KBA). The Instructional Technology team came together with our engineering teacher/amateur radio club sponsor, students from our newly formed high school club, and members of our local amateur radio club to host the event.

The experience served as an introduction to the world of amateur radio for students, parents, and community members. The goal was to increase awareness about the hobby and its potential for supporting skills found in district curriculum core subjects. Instructional Technology specialists dug into the curriculum to identify knowledge and skills that could be supported by amateur radio. They created multiple stations



Two students learn Morse code from Dallas M. Ward, K1DW (above). Community members take an interest in the software-defined radio table setup with John Elliott, KF5NXX, and Ron VanWinkle, N5YDX (upper right).

for all ages, where families could experience and record hands-on learning in their “Station Logbook.” Students had the opportunity to learn about electricity, circuits, geography, time zones, the metric system, and many other curriculum-related topics.

Throughout the event, Rockwall Amateur Radio Club (K5RKW) volunteers provided stations to showcase equipment, share expertise, and give students an opportunity to experience amateur radio in real time. Students were able to learn about different kinds of radios and antennas, software-defined radio, tracking satellites, “foxhunts,” and how to make a contact! The



event was structured to be both informative and engaging, with hands-on activities that encouraged participation.

By the end of the evening, attendees were inspired by the opportunities amateur radio offers. The collaboration between our high school club and local amateur radio operators proved to be an effective way to spread the word about this valuable and exciting hobby, showing students that technology and communication can be fun, community-focused, AND educational! We thank the ARRL Teachers Institute and the Rockwall Amateur Radio Club for making this opportunity possible!

Live Demonstrations of Ham Radio Electronics Help Build Ham Class Attendance

A Note from ARRL National Instructor Gordon West, WB6NOA



a hobby as well as a service. You must first sell what ham radio can impact to every student in the room in an entertaining way!

I take out my dual band HT and work up a pre-planned QSO over IRLP, D-Star, or Fusion with a pal halfway across the country. I then pick a student for their first contact — 3rd party traffic. Success — I give them their ARRL first contact certificate!

I loan each student a part 97 ARRL rule book and ask anyone to stand up and read 97.1(a). I play excerpts of real emergency hurricane traffic from my ON THE AIR Technician-class audio outtakes found on the ARRL Learning Center website. These emergency audio outtakes help illustrate the Q & As in the book for emergency traffic. I have students examine my laminated, cut-up GPO chart going from 10 Hz to 100 GHz, with tags showing where ham allocations are located.

I toss some foam squishy balls to illustrate how radio waves travel at the speed of light. THIS gets their attention! Every session needs live demos. Try decoding the 146.825 MHz Space Station Packet beacon, or the ISS cross band repeater. This outside operation generates excitement during a fresh air break. Remember to protect your students from beam element ends, as students are swinging it around looking for the best signal from the ISS. Safety is a number one requirement when pulling off live demos.

To illustrate the chapters on Ohm's law and Components, I rig up clear siphon tubing, colored

When students enter your weekly or weekend Technician Class, they are excited to see front tables loaded with ham radio equipment, rather than just a PowerPoint projector! Two tables house half your ham shack demos and will hold the interest of each student, showing them that this class won't be endless slides out of the book.

The entry-level Tech class is the hardest to teach, over General and Amateur Extra. Not only are you teaching the 400+ questions — of which 35 will be on their test — but your bigger job initially is to keep them excited to pass the test and get on the air. You gotta sell this weekend or 8-week training as something they will enjoy as both

water, a squeeze bulb, a clear beaker “source,” and a “load” beaker receiver. One squeeze of the bulb illustrates current, voltage, resistance, and the power of the demo! For questions about a diode, show it in action! Find your big diode, 12 V DC, a filament brake light, and a clear speaker wire, and have a student make a connection to light the light. When nothing happens, turn the diode around and the light comes on!

My ARRL free 36-page Instructor Guides are up to date to the new question pools for Technician and General classes. Every one of my classic demos is explained within the guides, and keyed to my ARRL Gordon West test prep books, which follow the question pool by topics. Teaching by topics is a feature I have used for over 40 years, and it cuts down on teaching time by keeping the similar topics together. These guides, plus videos and PowerPoint programs, are available to current ARRL members in the Learning Center.

Finally, as I tell my students, I come with the book — I am happy to speak with YOU as you plan your class, at 1-714-549-5000. And since Technician class Q & As will change in about a year, send me an email with suggestions of new or replacement Q & As for the new 2026 tech pool (wb6noa@arrl.net)!

Happy spring training!



ARRL Registered Instructor Clint Bradford, K6LCS, performs an ISS cross band repeater demonstration with his home brew Yagi (above). Tables are set up to display ham radio equipment and accessories for classroom instruction (above right).

As seen in this issue of *Radio Waves...*

Our 2025 Teachers Institute (TI) Applications are live! TI-1 is open to all US educators, and it is the only prerequisite for any of the 2025 TI Electives offered. Please visit our [TI webpage](#) to learn more about the sessions offered and complete an application if interested.

A big thank you to all those who made this edition possible.

Radio Waves aims to showcase how educators and license class instructors are getting their students and local communities involved in ham radio. These efforts deserve to be documented and shared. The contributors are teachers and instructors who are currently bringing amateur radio into the classrooms and beyond, just like you.

Many instructors and teachers made mention of materials and resources created by ARRL. Click any bullet to learn more about the item.

- [ARRL Teachers Institute](#)
- [ARRL Scholarships](#)
- [ARRL Instructor Resources](#)
- [ARRL Teaching Lesson Plans](#)

Add Your Voice: Write a short narrative about a specific teaching struggle, success, or learning breakthrough. We are seeking submissions of 300 – 500 words, and you are highly encouraged to send any pictures of yourself, your students, and the activities you introduced. Submissions can be sent to our email: radiowaves@arrl.org. Please use our [Model Release Form](#) for photos. Explore our [previous publications](#).

By submitting writing or photographs with completed model release forms, you grant ARRL permission to edit and use these materials for any publication purpose.

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