

RADIO WAVES

News you can use for license instruction
and radio science education

2025 - Issue 6



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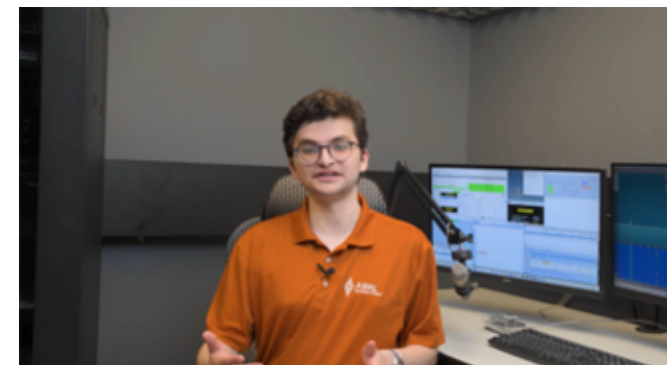
Gordon West shares how a lemon, a nail, and a copper penny can create a battery with current on page 4!

Fundamentals of Amateur Radio Contesting

Submitted by Max Freedman, N4ML
ARRL Education & Learning Support Specialist
Submitted 2025

QSO: 623
MULT: 194
 $623 \times 194 = 120,862$

Contest score calculation (screenshot from course).



Max Freedman, N4ML, explaining the rules of DX contests (screenshot from course).

One of the more recent Education Department initiatives has been updating our learning center with new courses. If you are unfamiliar with the learning center, it is ARRL's place for amateur radio educational material, designed for amateur radio operators. The focus here is skills development, whether that's getting or upgrading your license, learning how to get into a specific facet of amateur radio like Parks on the Air®, or much more. The learning center is also the host for our monthly On the Air Live webinar, which is a monthly hour-long live show about a host of rotating topics for the new amateur radio operator; we've covered topics like programming your handheld, SSTV, digital mode operation, and foxhunting.

The course update we're highlighting here is our new Fundamentals of Amateur Radio Contesting course. Contesting is a close analog to online gaming and provides a lot of the same experience. However, it can be a daunting task to get involved in if you're starting from scratch. Thus, our contesting course takes you through everything you need to set up your station for contesting, including how to operate a contest and guides on how to participate in the major contests. Video 3, for instance, goes into everything you need to know about making a contest station, and how to make changes to your ham shack for a contest.

ARRL's Learning Center serves as a great resource for your school club, as a place to send students for independent learning and to play in a club meeting to fill in areas where you may not be an expert. Check the full course out at learn.arrl.org!

CQ Santa

Written by Brenda Jasper, KJ5ADO
Submitted 2025

Looking for a way to involve elementary students in amateur radio? Here is an idea: After returning from my first ARRL Teachers Institute in the summer of 2023, ARRL provided me with ideas and equipment to start an after-school amateur radio club at my school, Angleton Christian School (ACS) in Angleton, Texas. ACS is a PK3 through 12th grade campus. The club consists of junior and senior high students, but during the first year, I was looking for a way to include our elementary students. One evening, while on the internet, I saw mention of The Santa Net hosted by The 3916 Nets. It runs nightly between Thanksgiving and Christmas, giving an opportunity for children to speak to “Santa” on an 80m frequency. At the time, the school was not set up for HF radio, and evenings were not convenient for the students. There is a good VHF/UHF repeater system located in the area, so I reached out to the local club with the idea of having a net one morning during December. At the same time, I reached out to the elementary teachers with the idea, and they loved it! During one of the last days before Christmas break, the elementary classes have a Polar Express Day, where students wear their pajamas, watch The Polar Express movie, and are visited by the Polar Express Conductor (a volunteer dressed as the conductor from the movie). According to the teachers, talking to “Santa” in the morning would make a great introduction to Polar Express Day.

I have done this event for the last two years with success. To help keep things educational and organized, each student is asked

to write a question to Santa and submit it to their teacher. One or two questions are chosen from each class to be read on the air. In the past, students have generated creative questions such as, “How does Santa tell the reindeer apart when they are not flying?” “How do the reindeer train for their Christmas Eve journey?” “What do the reindeer eat?” and “What do the elves do after Christmas?” Once I have a volunteer Santa, I compile the questions into an email and create possible answers. I want the volunteer to be comfortable by knowing the questions and not having to come up with answers on the fly. Google has some really good answers to the students’ questions! Of course, I encourage the volunteers to ad lib, if they like. My last two volunteers, Eric, KA5WMY, and Bill, KA9IKK, have done a marvelous job being Santa, and both have remarked afterward on how much fun they had during the



event. For each student, I print their question on a slip of paper, making it easier for them to ask their question. The first year, I brought in a mobile radio to use. But last year, we used handhelds, which worked much better. The students and I talked on one handheld while two others were placed around the room on high volume. By doing this, everyone was able to hear clearly.

I look forward to another successful Santa net this year, and I hope others can tailor this for their elementary students!

73 de KJ5ADO



Brenda Jasper, KJ5ADO, holding a handheld with a student speaking with Santa on the air. Students get ready to talk with Santa on the morning of their Polar Express Day at school.

Ohm's Law With a Lemon

Written by Gordon West, WB6NOA
Submitted 2025

It's back to school and classes time! One great way to greet your students is to have the front table loaded with ham "stuff" and tons of parts for your demos. This stuff lets them know they are attending an action-packed lab class, rather than watching a screen continuously at each class session. Teaching the entry-level Technician-class license may be more difficult than teaching General or Amateur Extra. You must cover hundreds of foreign topics with your Technician-class students. This is their first intro to ham radio — both the service and hobby. If you show only the PowerPoint for the full course, they will miss the feel and smell of live gear demonstrations that a ham radio license has to offer! The Technician-class question pool has about 20 questions on Ohm's Law; don't just use PowerPoint slides. Demonstrations really get their attention! More important than chalk talk or white-board calculations is showing and telling, so students can see, feel, and smell electrons in motion. Live equipment and component demonstrations add a real punch to your teaching techniques. At every class session, let your students take part in a live action demo! Watch the results and students' smiles.

A Current Lesson

Before we electrify a lemon, let them see examples of the flow of current. First, show how electrons travel in a conductor. Bring out a glass container filled with colored water and clear tubing. Explain that the tubing will serve as a conductor and let the far end hang down to a frosted glass on the floor. Give the

floor-end of the tube a sip to get the flow of potential (voltage) going as a steady current. Have a student slightly kink the tube to illustrate resistance; they have now created power if the glass container has water (electrons) to do the work for filling the glass below. A second out-of-sight frosted glass filled with confetti is a fun way to get their attention as you "spray" confetti over a willing student, making them think you are giving him or her a wet bath.

Next, create a real direct current demo with a small 3 Ah 12-volt battery, #16 AWG wire, an old potentiometer, a diode, a switch, and an automotive 12-volt running light. **We use a Bioenno Power lithium iron phosphate battery for safety.** It has a built-in battery monitoring system that will disconnect from the shorted load in less than 450 milliseconds if it detects excessive current and a drop in supply voltage. With these components temporarily wired in series, your students will have electrons at their fingertips to adjust the potentiometer for minimum or maximum bulb brilliance. If their diode is correctly hooked up to conduct, and if the switch is on, they can see and *carefully feel* the heat from the bulb. I always encourage instructors to have students **wear protective safety glasses for close demos.** Also, **warn them about the very hot light bulb!** This demo can be modified with added components that are asked about on the General- and Amateur Extra-class test, too. Afterward, hit the Ohm's book. Substitute a battery for voltage potential (E), current for the stream going down the tube (I), resistance in the small clear tube (R), and the glass filling up with water. Don't forget to show students the simple math for determining an unknown value in your circuit.

Lemon DX

All students get a lemon, a nail, and a copper penny. When students insert these two dissimilar metals into the lemon, they create a battery with current, which you can read with a micro ammeter. A voltmeter will show voltage as well. You should get about a half volt of potential and a few micro amps of current flow. This adds galvanic chemistry to this visual demo! To finalize this demo in upcoming sessions, string the lemons in series and parallel, and develop enough voltage (about 7 volts) and current to drive a handheld on micro low power (EL) on 146.520 MHz. After that, let a student make a two-way contact — third party — to a fellow instructor outside in the parking lot. Watch the students play with the meter leads when exploring voltage points and conductivity! This demo is one of many that a class can see in the slides and videos in the ARRL Learning Center.

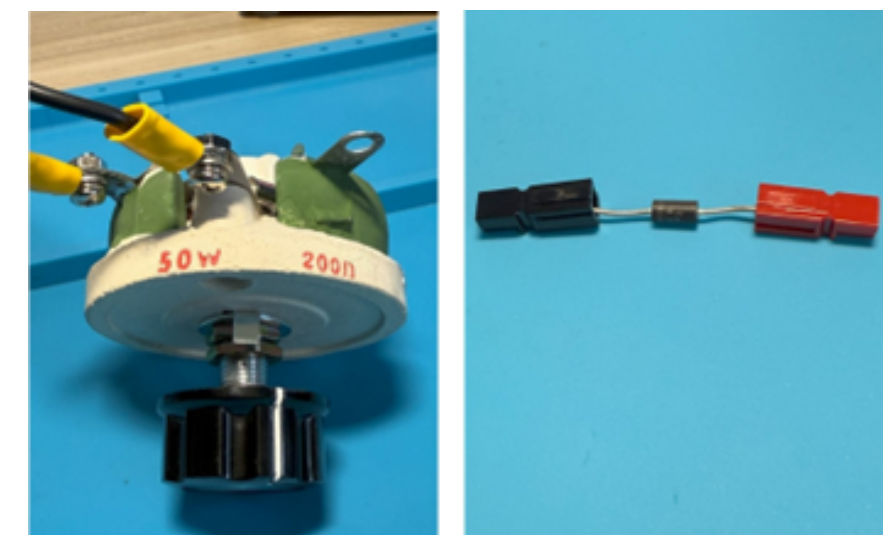
A fun contributor for a host of free video demos is ARRL Registered fellow Instructor Gary Johnson, AA6GJ, and his wife Debra, WB6LVC. You and your students may freely download their library of ham radio test preparation live demos. Start viewing for free here: <https://vimeo.com/garyjohnson/videos>. There are also free audio

sounds on the air, a home study for each license level, and my instructor guide for Technician-, General-, and Amateur Extra-class at the ARRL Learning Center.

Best teaching success from all of us at the American Radio Relay League!



Rheostat set to full brightness. Diode inserted and forward biased, allowing current to flow. Light bulb voltage is 11.9 Volts.



50 Watt, 200 Ω Potentiometer wired as a rheostat (Above left). MR 851 Rectifier Diode (Above right).

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

This October, the Education & Technology Program (ETP) will again offer two types of grants: the ETP School Station Grant and the ETP Progress Grant. The former grant is awarded to schools that provide a detailed plan to use amateur radio as part of an school enrichment program, club and/or as part of classroom learning. The latter, more modest grant is intended for teachers who are already using amateur radio in their classrooms or for teachers who need resources to get started instructing wireless technology and electronics topics as part of a longer-range plan to involve amateur radio. Please visit our webpage for updates regarding the 2025 grant timeline: arrrl.org/etp-grants.

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@arrrl.org. Please use our [Model Release Form](#) for photos. Explore our [previous publications](#).

