



Radio

Scouts BSA · STEM

Name

Started

Completed

Radio lets people talk across towns, oceans, and even space. You'll learn how radio waves work, the rules for using them, and how radio helps in emergencies. You might even make your first contact with another operator.

Requirements

Every official requirement, in plain language. Check the official wording when you sign off (scouting.org/merit-badges/radio/). Tips and examples are ideas, not extra requirements.

1 Radio safety

Tips for this section: Learn the safety rules for antennas and power, like staying away from power lines.

- ☐ **1a** Explain safety precautions for grounding radio gear: AC and DC circuits, power outlets, antennas, and lightning

- ☐ **1b** Explain how to prevent and treat electrical burns

- ☐ **1c** Explain how to keep lithium-ion batteries in phones and other devices from catching fire

2 Radio fundamentals

Tips for this section: Make flash cards for key terms and components, and look at real equipment if you can.

Example for this section: Make a chart of the radio spectrum from AM broadcast to FM, aviation, ham bands, Wi-Fi, and GPS. Explain frequency and wavelength with a jump rope: shake it faster and the waves get shorter.

2a Spectrum chart

- ☐ **2a1** Make a chart of the electromagnetic spectrum from 300 kHz (kilohertz) up to 3,000 MHz (megahertz)

- ☐ **2a2** Mark the MF, HF, VHF, UHF, and microwave parts of the spectrum on your chart

- ☐ **2a3** Place at least eight radio services on your chart, such as AM and FM broadcast, CB, TV, amateur radio (at least four ham bands), police and fire, Wi-Fi, cellular, and Bluetooth

2b Radio basics discussion

- ☐ **2b1** Discuss with your counselor what radio is

- ☐ **2b2** Discuss with your counselor how broadcast radio differs from two-way radio

- ☐ **2b3** Discuss with your counselor how commercial broadcast radio differs from hobby radio

3 How radio waves travel

Tips for this section: Draw a picture showing how radio waves travel near the ground and bounce off the sky.

Example for this section: Draw three paths: a ground wave hugging the Earth for AM stations, a sky wave bouncing off the ionosphere at night so you can hear far-off stations, and line-of-sight for FM and repeaters. Explain why AM reaches farther after dark.

- ☐ **3a** Sketch a diagram of how radio signals of different wavelengths travel short distances or all the way around the world

- ☐ **3b** Explain how listening to time stations WWV and WWVH helps you predict what you'll be able to hear on a shortwave radio

- ☐ **3c** Explain how a distant (DX) station differs from a local one

4 Information by radio

Tips for this section: Talk about how voice, music, and data get carried by radio, like Wi-Fi and digital radio.

- ☐ **4a** Discuss with your counselor how radio waves carry information using CW Morse code, AM, FM, single sideband (SSB), and frequency hopping

- ☐ **4b** Discuss with your counselor how digital standards like Bluetooth, Wi-Fi, and 5G can send and receive data more reliably than analog ones

- ☐ **4c** Discuss with your counselor how effective range changes with the way information is encoded

- ☐ **4d** Discuss with your counselor how a Wi-Fi system's top data rate compares with a wired or fiber-optic connection

5 Radio hardware and services

Tips for this section: Draw simple block diagrams, and learn how NOAA weather alerts can warn people of danger.

Example for this section: Draw a block diagram of a radio station: a microphone into the transmitter, a receiver out to a speaker, a transceiver that does both, an amplifier, and the feedline up to the antenna. Then explain how NOAA Weather Radio sends alerts for your county and why every home should have a way to receive them.

- ☐ **5a** Explain how a block diagram differs from a schematic diagram

- ☐ **5b** Draw a block diagram of a radio station showing a microphone, a speaker, a transceiver, a transmitter, a receiver, an amplifier, the feedline, and the antenna, and discuss what each part does

- ☐ **5c** List consumer devices and services that communicate by analog or digital radio

- ☐ **5d** Explain how NOAA Weather Radio (NWR) can warn you of danger

- ☐ **5e** Explain how RFID works and some of the ways it's used in daily life

6 Radio regulation

Tips for this section: Practice spelling your name with the phonetic alphabet, and find out what call signs are.

Example for this section: Explain that the FCC licenses radio users, show what a call sign looks like and how it tells you a station's country, and spell your Scout troop's name aloud using the phonetic alphabet.

- ☐ **6a** Discuss with your counselor what the FCC does and how it differs from the International Telecommunication Union (ITU)

- ☐ **6b** Discuss with your counselor how call signs are used in broadcast and amateur radio

- ☐ **6c** Discuss with your counselor how the phonetic alphabet helps people communicate clearly

7 Cell phones

Tips for this section: Look up how cell towers work and why phones can still reach emergency services.

- ☐ **7a** Explain how cellular systems are different from broadcast and hobby radio

- ☐ **7b** Explain what Airplane Mode is and why it matters

- ☐ **7c** Explain how cell phones keep accurate time and show your location and elevation

- ☐ **7d** Explain what cell phones can and can't do for you in an emergency

- ☐ **7e** Explain how wireless charging works for phones and other devices

8 Amateur and professional radio: Choose 1 of 5

Tips for this section: Visit a local amateur radio club or a radio station to try the option you choose.

Example for this section: For the amateur radio option, visit a club with a parent and, with a licensed operator supervising, make a 10-minute contact: use call signs and Q signals, trade signal reports, and share your first name, where you are, and the weather. Log the call sign, time, frequency, and signal report.

8a Option A: amateur radio

- ☐ **8a1** Tell why the FCC created an amateur radio service, and describe what licensed hams can do on the air

- ☐ **8a2** Explain how Technician, General, and Extra Class licenses differ in requirements and privileges, and who gives amateur radio exams

- ☐ **8a3** Explain five or more Q signals or ham radio terms

- ☐ **8a4** Explain how you would make an emergency call by voice or Morse code

- ☐ **8a5** Explain how handheld, mobile, and base station transceivers differ and what each is used for, and explain how amateur repeaters are used

- ☐ **8a6** Hold a 10-minute real or simulated ham contact by voice, Morse code, or digital mode using proper call signs, Q signals, and abbreviations; log it correctly and record the signal report. Licensed hams may instead show five QSL cards from five operators

8b Option B: radio broadcasting

- ☐ **8b1** Discuss FCC broadcast rules with your counselor, including power levels, frequencies, and rules for low-power stations

- ☐ **8b2** Plan a program schedule exactly 30 minutes long for station "KBSA" with music, news, commercials, and proper station ID, then record it on audiotape or digital audio using good technique

- ☐ **8b3** Listen to 15 broadcast stations and log them correctly. For five of them, figure out the program format and target audience

- ☐ **8b4** Explain to your counselor eight or more commercial broadcasting terms, for example segue, cut, fade, continuity, remote, network, cue, dead air, PSA, playlist, or Emergency Alert System

- ☐ **8b5** Discuss other ways radio is delivered with your counselor, like podcasts, satellite radio, and internet streaming

8c Option C: shortwave and medium-wave listening

- ☐ **8c1** Tune across several shortwave bands in four sessions of one hour each, with at least one in daylight and one at night. Log the stations and find them on a map, globe, or online map

- ☐ **8c2** Tune in several medium-wave stations in two sessions of one hour each, one in daylight and one at night. Log the stations and find them on a map, globe, or online map

- ☐ **8c3** Compare your day and night logs, note the frequencies where your chosen stations came in loudest each session, and explain why signal strength changed

- ☐ **8c4** Compare your medium-wave logs and explain why some faraway stations can only be heard where you live at night

- ☐ **8c5** Show how to listen to a radio broadcast on a smartphone or cell phone, including international broadcasts

8d Option D: amateur radio direction finding

- ☐ **8d1** Describe amateur radio direction finding (ARDF) and why direction finding matters as an activity and as a competition

- ☐ **8d2** Describe the frequencies and equipment used for ARDF or fox hunting

- ☐ **8d3** Build a simple directional antenna for one of the two ARDF frequencies

- ☐ **8d4** Take part in a simple fox hunt with your antenna and a receiver that's provided

- ☐ **8d5** Show on a map how you found the "fox" with your receiver

8e Option E: FRS and GMRS walkie-talkies

- ☐ **8e1** Explain what FRS (Family Radio Service) and GMRS (General Mobile Radio Service) are, how they differ from each other, and how they differ from other commercial two-way radios, CB, and ham radio

8e2 Using FRS radios and GMRS walkie-talkies

- ☐ **8e2a** Explain whether you need a license to use these radios, and if so, which kind

- ☐ **8e2b** Explain which radio frequencies they use and how information is encoded

- ☐ **8e2c** Explain how much transmitting power is allowed

- ☐ **8e2d** Explain what kinds of antennas may be used

- ☐ **8e2e** Explain their effective range and what limits it

- ☐ **8e2f** Explain what these radios are commonly used for day to day

- ☐ **8e2g** Explain how these radios can help in an emergency

- ☐ **8e3** Use FRS or GMRS radios with Scouts, friends, or family during a hike, a team game, or an event, then discuss what you learned with your counselor

9 Careers and hobbies: Choose 1 of 2

Tips for this section: Ask a ham operator or radio engineer how they got into radio.

- ☐ **9a** Research one radio career (training, education, costs, job outlook, pay, duties, advancement), with a parent's OK for online searches, interviews, or visits, and discuss what you found and your interest with your counselor

- ☐ **9b** Research how radio skills could become a hobby or volunteer service (if possible, interview a hobbyist or volunteer with a parent's OK), including training, licenses, costs, and groups, and discuss your goals with your counselor