



Radio Merit Badge Workbook - Amateur Radio

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Scouts participating in a Scoutmaster Bucky merit badge opportunity, whether online or in person, should consider using the Radio merit badge pamphlet for discovery and knowledge, along with the class preparation pages for clarifications, insights, and expectations.

<https://scoutmasterbucky.com/merit-badges/radio/radio-pamphlet.pdf>

<https://scoutmasterbucky.com/merit-badges/radio/radio-cpp.pdf>

REQUIREMENT 7 REQUIRES COUNSELOR APPROVAL.

REQUIREMENT 1: Explain what radio is.

Notes:

REQUIREMENT 1a: Discuss the differences between broadcast radio and hobby radio.

Notes:

REQUIREMENT 1b: Discuss the differences between broadcasting and two-way communications.

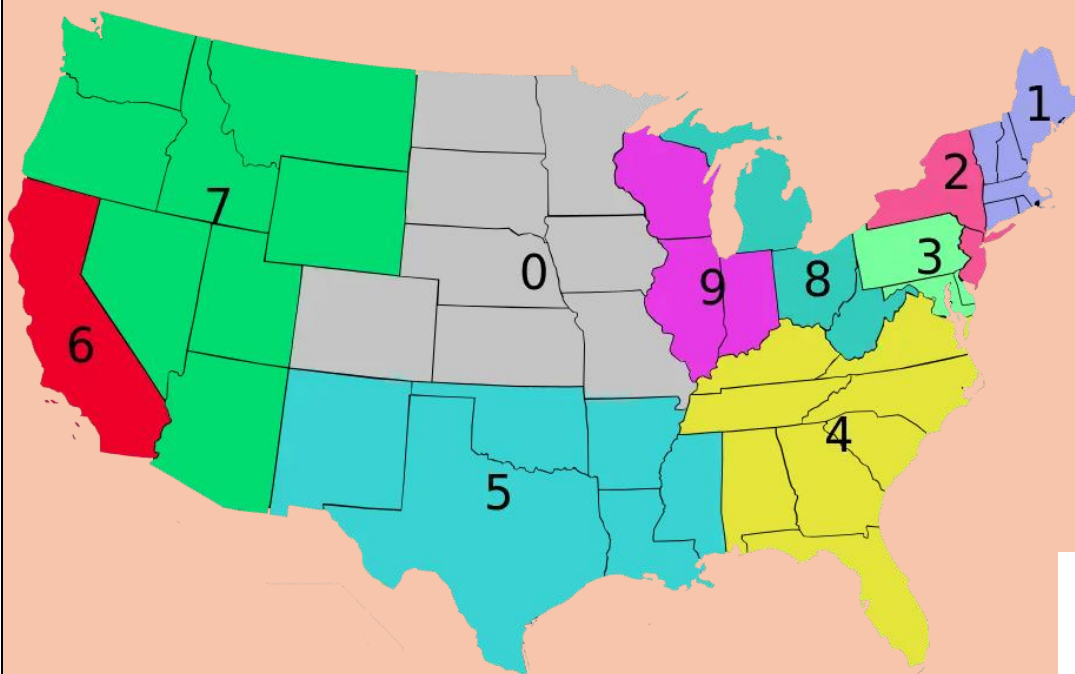
Notes:



Radio Merit Badge Workbook - Amateur Radio

SCOUTMASTER BUCKY

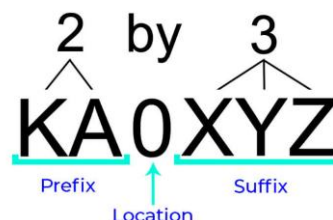
REQUIREMENT 1c: Discuss radio station call signs and how they are used in broadcast radio and amateur radio.



The area code is followed by three letters called the suffix. They are assigned sequentially from the pool. These call signs are called “2-by-3,” or “2×3,” call signs because two letters precede the number, and three letters follow the number. As shown in Figure x below, KA0XYZ is an example of a 2-by-3 callsign

A ham radio call sign is a unique identifier that is assigned to an amateur radio operator. It is used to identify the operator and their location, and is typically a combination of letters and numbers.

Call signs begin with K, followed by a second letter and a number that indicates what call sign area you’re in. This is called the call sign prefix. After the prefix is a single number. The single number indicates the area.



Notes:



Radio Merit Badge Workbook - Amateur Radio

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REQUIREMENT 1d: Discuss the phonetic alphabet and how it is used to communicate clearly.

Poor atmospheric conditions with HF communications, weak signal strength, interference from other stations or emitters, and other environmental factors can degrade the quality of received audio. Even in good conditions many words and alphabetic characters sound similar. The letters B, C, D, E, G, P, T, V, and Z offer salient examples of similar sounding letters whose differentiation depends strictly upon the beginning phoneme that is commonly comprised of quite high audio frequency components that may not clearly survive the modulation-demodulation process.

Using a standard phonetic alphabet works very well to improve communications. A phonetic alphabet consists of a word to represent each letter of the alphabet. For instance, 'A' is represented by the word 'Alpha.' Since words contain more phonemes than letter names, and frequently even multiple syllables, there is redundant audio information transmitted that helps the receiving operator more easily identify or distinguish the letter.

The International Telecommunications Union (ITU) adopted a standard phonetic alphabet in 1959 based upon the preceding phonetic alphabet of the International Civil Aviation Organization (ICAO). These standard phonetics changed and evolved into the adopted standard over the course of a few years following World War II, ensuring their acceptability and uniqueness among international languages.

It is a good idea with international contacts to utilize the ITU standard phonetics rather than alternative phonetics. The international standard phonetic terms are recognizable as such around the world, and they are less likely to be confused for other words or meanings than non-standard phonetics.

The standard ITU phonetic alphabet is depicted here. Particularly in noisy single sideband (SSB) phone mode conditions, operators will use phonetics regularly for station identification, for relating operator name, and location

| | | |
|--------------------|---------------------|--------------------|
| A – Alpha | J – Juliet | S – Sierra |
| B – Bravo | K – Kilo | T – Tango |
| C – Charlie | L – Lima | U – Uniform |
| D – Delta | M – Mike | V – Victor |
| E – Echo | N – November | W – Whiskey |
| F – Foxtrot | O – Oscar | X – X-Ray |
| G – Golf | P – Papa | Y – Yankee |
| H – Hotel | Q – Quebec | Z – Zulu |
| I – India | R – Romeo | |

The International Telecommunications Union
Standard Phonetic Alphabet

Notes:



REQUIREMENT 2a: Sketch a diagram showing how radio waves travel locally and around the world.

Notes:

REQUIREMENT 2b: Explain how the radio stations WWV and WWVH can be used to help determine what you can expect to hear when you listen to a shortwave radio.

Notes:



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REQUIREMENT 2c: Explain the difference between a distant (DX) and a local station.

Notes:

REQUIREMENT 2d: Discuss what the Federal Communications Commission (FCC) does and how it is different from the International Telecommunication Union.

Notes:



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| | |
|------------------------|--|
| REQUIREMENT 3a: | Draw a chart of the electromagnetic spectrum covering 300 kilohertz (kHz) to 3,000 Megahertz (MHz). |
| REQUIREMENT 3b: | Label the MF, HF, VHF, UHF, and microwave portions of the spectrum on your diagram. |
| REQUIREMENT 3c: | Locate on your chart at least eight radio services, such as AM and FM commercial broadcast, citizens band (CB), television, amateur radio (at least four amateur radio bands), and public service (police and fire). |

Notes:



REQUIREMENT 4: Explain how radio waves carry information.

Notes:

REQUIREMENT 4: Explain: transceiver, transmitter, receiver, amplifier, and antenna.

Transceiver:

Transmitter:

Receiver:

Amplifier:

Antenna:



REQUIREMENT 5a: Explain the differences between a block diagram and a schematic diagram.

Notes:

REQUIREMENT 5b: Draw a block diagram for a radio station that includes a transceiver, amplifier, microphone, antenna, and feed line.

Notes:



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REQUIREMENT 5c: Discuss how information is sent when using amplitude modulation (AM), frequency modulation (FM), continuous wave (CW) Morse Code transmission, single sideband (SSB) transmission, and digital transmission.

Amplitude Modulation (AM):

Frequency Modulation (FM):

Continuous Wave (CW) Morse Code Transmission:

Single Sideband (SSB) Transmission:

Digital Transmission:



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REQUIREMENT 5d: Explain how NOAA Weather Radio (NWR) can alert you to danger.

Notes:

REQUIREMENT 5e: Explain how cellular telephones work.

Notes:

REQUIREMENT 5e: Identify the benefits and limitations in an emergency for cellular telephones.

Notes:



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REQUIREMENT 6:

Explain the safety precautions for working with radio gear, including the concept of grounding for direct current circuits, power outlets, and antenna systems.

Notes:

Grounding for Direct Current Circuits:

Power Outlets:

Antenna Systems:



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REQUIREMENT 7:

Visit a radio installation (an amateur radio station, broadcast station, or public service communications center, for example) approved in advance by your counselor. Discuss what types of equipment you saw in use, how it was used, what types of licenses are required to operate and maintain the equipment, and the purpose of the station.

Radio Installation and Location to Visit:

COUNSELOR APPROVAL: IS REQUIRED.

Counselor's Name

Phone or Email

Counselor's Signature

Date

☐

approved

Equipment you saw in use:

Type of licenses required to operate and maintain:

Purpose of the station:



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REQUIREMENT 8: Find out about three career opportunities in radio.

Career Opportunity #1:

Career Opportunity #2:

Career Opportunity #3:

REQUIREMENT 8: Pick one and find out the education, training, and experience required for this profession. Discuss this with your counselor.

Selected Career Opportunity:

Education Requirements:

Training Requirements:

Experience Requirements:



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REQUIREMENT 8: Explain why this profession might interest you.

Notes:





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Requirement 9a - Amateur Radio

REQUIREMENT 9a1: Tell why the FCC has an amateur radio service.

Notes:

REQUIREMENT 9a1: Describe activities that amateur radio operators can do on the air, once they have earned an amateur radio license.

Notes:



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REQUIREMENT 9a2: Explain differences between the Technician, General, and Extra Class license requirements and privileges.

The FCC currently issues three Amateur Radio Service (ham radio) licenses: Technician, General, and Extra licenses. Technician is considered the "entry level" license, while Extra is the top-level license. You must earn each license in sequence, Tech, Gen, Extra. Each step up in license type provides expanded privileges to transmit on the variety of radio bands allocated by the FCC for the Amateur Radio Service.

The Technician license grants transmitting privileges on the VHF and UHF bands most commonly used for local area communications. The signals using these frequency ranges do not typically travel beyond the radio horizon, the distance limiting signal propagation due to the curvature of the earth and local terrain features. However, repeater stations positioned atop towers, hills and mountains, or tall buildings are highly effective at instantaneously retransmitting your VHF and UHF signals greater distances due to the expanded horizon produced by those high vantage points and usually by increased power of the retransmissions. Further, repeater stations at disparate locations can be linked together through internet connectivity or using auxiliary radio relays, potentially providing hundreds of miles of coverage for your VHF/UHF transceiver.

The Tech license also provides transmitting privileges on small segments of some HF bands allowing communication around the world via skip propagation using the earth's ionosphere. HF signals are bent back toward the earth by the charged particles in the ionosphere, sending your signals over the horizon thousands of miles. Multiple skips of a transmitted radio signal can literally send it completely around the planet. The Tech license provides limited privilege to transmit by voice (phone mode) on one HF band and by continuous wave (CW, using Morse Code) on additional bands.

The General license maintains all the Tech license privileges and expands your transmitting privileges to limited segments of all of the HF bands allocated to the Amateur Radio Service. Essentially, the General license opens the world of long-distance, international communication to you, as well as greatly increasing the voice mode operations on the HF bands. With access to the range of HF bands, you can communicate with operators around the globe, across the continent, or right next door using voice, CW, or digital modes of radio signals. The General license requires increased knowledge of the common operating modes and practices for HF communications as well as more advanced digital communications techniques and electronics competency.

The Extra license adds privileges to operate on additional segments of the HF bands beyond those provided by the General license. This license upgrade provides full access to the range of bands allocated to the Amateur Radio Service. The Extra license represents a significant increase in knowledge of radio science, electronics, and operating techniques

TECHNICIAN LICENSE:

Requirements:

Privileges:



Radio Merit Badge Workbook - Amateur Radio

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GENERAL LICENSE:

Requirements:

Privileges:

EXTRA CLASS LICENSE:

Requirements:

Privileges:

REQUIREMENT 9a2: Explain who administers amateur radio exams.

Notes:





Radio Merit Badge Workbook - Amateur Radio

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REQUIREMENT 9a3: Explain at least five Q signals or amateur radio terms.

Originally intended for use only by radiotelegraph operators, Q-Codes (also called Q-Signals) are three letter combinations that begin with the letter Q that CW operators use in place of common phrases.

QR CODE OR TERM #1:

Code / Term:

What it means sending:

What it means receiving:

QR CODE OR TERM #2:

Code / Term:

What it means sending:

What it means receiving:

QR CODE OR TERM #3:

Code / Term:

What it means sending:

What it means receiving:

QR CODE OR TERM #4:

Code / Term:

What it means sending:

What it means receiving:

QR CODE OR TERM #5:

Code / Term:

What it means sending:

What it means receiving:



REQUIREMENT 9a4: Explain how you would make an emergency call on voice or Morse code.

Notes:

REQUIREMENT 9a5: Explain the differences between handheld, mobile, and base station transceivers and their uses.

Handheld:

Mobile:

Base Station:



Radio Merit Badge Workbook - Amateur Radio

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REQUIREMENT 9a5: Explain the use of amateur radio repeaters.

Notes:

REQUIREMENT 9a6: Using proper call signs, Q signals, and abbreviations, carry on a 10-minute real or simulated amateur radio contact using voice, Morse code, or digital mode. (Licensed amateur radio operators may substitute five QSL cards as evidence of contacts with five amateur radio operators. Properly log the real or simulated ham radio contact, and record the signal report.).

Consider using the [Radio Merit Badge Pamphlet](#) for preparation information

This requirement must be reviewed with your merit badge counselor.

BE PREPARED!

Notes: