



# SCOUTMASTER BUCKY

## Radio Merit Badge Workbook

[ScoutmasterBucky.com](http://ScoutmasterBucky.com) or [ScoutmasterBucky@yahoo.com](mailto:ScoutmasterBucky@yahoo.com) or 612-483-0665

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. These resources are available here:

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

### REQUIREMENT 7 REQUIRES COUNSELOR APPROVAL.

#### REQUIREMENT 1: Explain the safety precautions for working with radio gear.

Notes:

#### REQUIREMENT 1a: Explain the safety precautions for grounding direct and alternating current circuits, power outlets, antennas, and lightning.

Grounding for direct current circuits:

Grounding for alternating current circuits:

Grounding for power outlets:



Grounding for antennas:

Grounding for lightning:

**REQUIREMENT 1b:** Explain the safety precautions for preventing and treating electrical burns.

Preventing:

Treating:



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**REQUIREMENT 1c:** Explain the safety precautions for preventing lithium-ion battery fires in cell phones and other devices.

Notes:

**REQUIREMENT 2a1:** Draw a chart of the electromagnetic spectrum covering 300 kilohertz (kHz) to 3,000 Megahertz (MHz).

**REQUIREMENT 2a2:** Label the MF, HF, VHF, UHF, and microwave portions of the spectrum on your diagram.

**REQUIREMENT 2a3:** 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 2b1:** Discuss with your counselor, the definition of radio.

Notes:

**REQUIREMENT 2b2:** Discuss with your counselor, the differences between broadcast radio and two-way radio.

Notes:

**REQUIREMENT 2b3:** Discuss with your counselor, the differences between commercial broadcast radio and hobby radio.

Notes:



**REQUIREMENT 3a:** Sketch a diagram showing how radio waves travel locally and around the world.

Notes:

**REQUIREMENT 3b:** 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:



**REQUIREMENT 3c:** Explain the difference between a distant (DX) and a local station.

Notes:

**REQUIREMENT 4a:** Discuss with your counselor how radio waves carry information using continuous wave (CW) Morse Code transmission.

Notes:

**REQUIREMENT 4a:** Discuss with your counselor how radio waves carry information using amplitude modulation (AM).

Notes:



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**REQUIREMENT 4a:** Discuss with your counselor how radio waves carry information using frequency modulation (FM).

Notes:

**REQUIREMENT 4a:** Discuss with your counselor how radio waves carry information using single sideband (SSB) transmission.

Notes:

**REQUIREMENT 4a:** Discuss with your counselor how radio waves carry information using frequency hopping.

Notes:



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**REQUIREMENT 4b:** Discuss with your counselor how digitized radio standards including Bluetooth, Wi-Fi, and 5G can offer more reliable data transmission and reception than analog standards

Bluetooth:

Wi-Fi:

5G:

**REQUIREMENT 4c:** Discuss with your counselor how the effective range varies for different methods of information encoding.

Notes:



**REQUIREMENT 4d:** Discuss with your counselor how the maximum data rate from a Wi-Fi radio system compares to a hard-wired or fiber-optic system.

Notes:

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

Block Diagram:

Schematic Diagram:



**REQUIREMENT 5b:** Draw a block diagram for a radio station that shows a microphone, speaker, transceiver, transmitter, receiver, amplifier, feedline, and antenna and discuss the function of these components.

Notes:



**REQUIREMENT 5c:** List consumer devices and services that use analog or digital radio communications.

Analog	Digital

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

Notes:

**REQUIREMENT 5e:** Explain how RFID works/

Notes:

**REQUIREMENT 5e:** Explain some RFID uses in everyday life.

Notes:



**REQUIREMENT 6a:** Discuss with your counselor what the Federal Communications Commission (FCC) does and how it is different from the International Telecommunication Union.

Notes:

**REQUIREMENT 6a:** Discuss with your counselor what the Federal Communications Commission (FCC) does and how it is different from the International Telecommunication Union.

Notes:

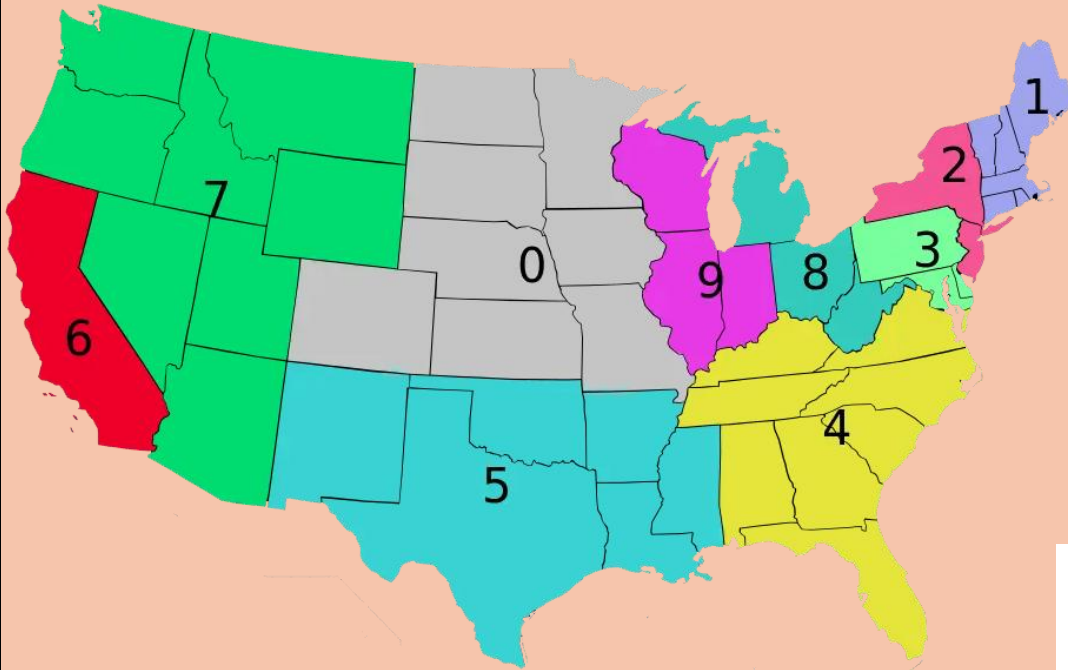


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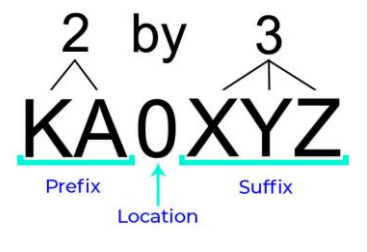
**REQUIREMENT 6b:** Discuss with your counselor how radio station call signs are used in broadcast radio and amateur radio.



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.

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 "2x3," 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 call sign



Notes:



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**REQUIREMENT 6c:** Discuss with your counselor how 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

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

The International Telecommunications Union  
Standard Phonetic Alphabet

Notes:



**REQUIREMENT 7a:** Explain how cellular systems differ from broadcast and hobby radio.

Notes:

**REQUIREMENT 7b:** Explain what Airplane Mode is and why it is important.

Notes:

**REQUIREMENT 7c:** Explain how cell phones keep the correct time and show locations and elevations.

Notes:

**REQUIREMENT 7d:** Explain the benefits and limitations of cell phones in emergencies.

Notes:



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**REQUIREMENT 7e:** Explain wireless charging for cell phones and other devices.

Notes:





**DO ONE OF THE FOLLOWING OPTIONS (A, B, C, D, or E) FOR REQUIREMENT 8**

### Req 8 Option A - Amateur Radio

**REQUIREMENT 8a1:** Tell why the FCC has an amateur radio service.

Notes:

**REQUIREMENT 8a1:** Describe activities that amateur radio operators can do on the air once they have earned an amateur radio license.

Notes:



**REQUIREMENT 8a2:** 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:



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### GENERAL LICENSE:

Requirements:

Privileges:

### EXTRA CLASS LICENSE:

Requirements:

Privileges:

**REQUIREMENT 8a2:** Explain who administers amateur radio exams.

Notes:





**REQUIREMENT 8a3:** 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 8a4:** Explain how you would make an emergency call on voice or Morse code.

Notes:

**REQUIREMENT 8a5:** Explain the differences between handheld, mobile, and base station transceivers and their uses.

Handheld:

Mobile:

Base Station:



**REQUIREMENT 8a5:** Explain the use of amateur radio repeaters.

Notes:

**REQUIREMENT 8a6:** 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.)

**Note:** Licensed amateur radio operators may substitute five QSL cards as evidence of contacts with five amateur radio operators

Consider using the Radio Merit Badge Pamphlet for preparation information

**This requirement must be reviewed with your merit badge counselor.**

**BE PREPARED!**

Notes:



### Req 8 Option B - Radio Broadcasting

**REQUIREMENT 8b1:** Discuss with your counselor FCC broadcast regulations. Include power levels, frequencies, and the regulations for low-power stations.

Notes:

Power Levels:

Frequencies:

Low-Power Station Regulations:



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**REQUIREMENT 8b2:** Prepare a program schedule for radio station "KBSA" of exactly one-half hour, including music, news, commercials, and proper station identification. Record your program on audiotape or in a digital audio format, using proper techniques.

The following pages have been set up so that you can develop your 30-minute program with ease. Each line represents 15 seconds of time. Standard PSAs (Public Service Announcements) and commercials are either 15 or 30 seconds in length. While call station identifications can be shorter, for this exercise consider your call station identification to include a little lead in or jingle to accompany it for the 15 seconds.

A Station identification is usually the Call Sign with a fun catch phrase:

**"KBSA, Where We Turn Good Music, News, and Fun, Daily"**

Use this area to write your station identification script:

Notes:



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### Programming Schedule

Time	Music / News / Commercial / Station Identification / Other	Short Description / Notes	Who does this
0:00:00			
0:00:15			
0:00:30			
0:00:45			
0:01:00			
0:01:15			
0:01:30			
0:01:45			
0:02:00			
0:02:15			
0:02:30			
0:02:45			
0:03:00			
0:03:15			
0:03:30			
0:03:45			
0:04:00			
0:04:15			
0:04:30			
0:04:45			
0:05:00			
0:05:15			
0:05:30			
0:05:45			
0:06:00			
0:06:15			
0:06:30			
0:06:45			
0:07:00			
0:07:15			
0:07:30			



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Time	Music / News / Commercial / Station Identification / Other	Short Description / Notes	Who does this
0:07:45			
0:08:00			
0:08:15			
0:08:30			
0:08:45			
0:09:00			
0:09:15			
0:09:30			
0:09:45			
0:10:00			
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0:10:30			
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0:14:45			
0:15:00			
0:15:15			



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### Programming Schedule

Time	Music / News / Commercial / Station Identification / Other	Short Description / Notes	Who does this
0:15:30			
0:15:45			
0:16:00			
0:16:15			
0:16:30			
0:16:45			
0:17:00			
0:17:15			
0:17:30			
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0:21:30			
0:21:45			
0:22:00			
0:22:15			
0:22:30			
0:22:45			
0:23:00			



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### Programming Schedule

Time	Music / News / Commercial / Station Identification / Other	Short Description / Notes	Who does this
0:23:15			
0:23:30			
0:23:45			
0:24:00			
0:24:15			
0:24:30			
0:24:45			
0:25:00			
0:25:15			
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0:27:00			
0:27:15			
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0:27:45			
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0:28:15			
0:28:30			
0:28:45			
0:29:00			
0:29:15			
0:29:30			
0:29:45			
0:30:00			

# KBSA



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**REQUIREMENT 8b3:** Listen to and properly log 15 broadcast stations. Determine the program format and target audience for five of these stations.

#	Call Sign & City if noted	AM / FM / Other	Program Format	Target Audience
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				



**REQUIREMENT 8b4:** Explain to your counselor at least eight terms used in commercial broadcasting, such as segue, cut, fade, continuity, remote, Emergency Alert System, network, cue, dead air, PSA, and play list.

segue:

cut:

fade:

continuity:

remote:



Emergency Alert System:

network:

cue:

dead air:

PSA:

play list:



**REQUIREMENT 8b5:** Discuss with your counselor alternative radio platforms such as internet streaming, satellite radio, and podcasts.

Internet Streaming:

Satellite Radio:

Podcasts:















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**REQUIREMENT 8c3:** Compare your daytime and nighttime logs; note the frequencies on which your selected stations were loudest during each session. Explain differences in the signal strength from one period to the next.

Notes:

**REQUIREMENT 8c4:** Compare your medium-wave broadcast station logs and explain why some distant stations are heard at your location only during the night.

Notes:

**REQUIREMENT 8c5:** Demonstrate listening to a radio broadcast using a smartphone/cell phone. Include international broadcasts in your demonstration.

Consider using the Radio Merit Badge Pamphlet for preparation information

**This requirement must be reviewed with your merit badge counselor.**

**BE PREPARED!**



### Req 8 Option D - Amateur Radio Direction Finding

**REQUIREMENT 8d1:** Describe amateur radio direction finding.

Notes:

**REQUIREMENT 8d1:** Explain why direction finding is important as both an activity and in competition.

Notes:



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**REQUIREMENT 8d2:** Describe what frequencies and equipment are used for ARDF or fox hunting.

Notes:

**REQUIREMENT 8d3:** Build a simple directional antenna for either of the two frequencies used in ARDF.

Consider using the Radio Merit Badge Pamphlet for preparation information

**This requirement must be reviewed with your merit badge counselor.**

**BE PREPARED!**

**REQUIREMENT 8d4:** Participate in a simple fox hunt using your antenna along with a provided receiver.

Consider using the Radio Merit Badge Pamphlet for preparation information

**This requirement must be reviewed with your merit badge counselor.**

**BE PREPARED!**

**REQUIREMENT 8d5:** Show, on a map, how you located the "fox" using your receiver.

Consider using the Radio Merit Badge Pamphlet for preparation information

**This requirement must be reviewed with your merit badge counselor.**

**BE PREPARED!**





### Req 8 Option E - Family Radio Service (FRS) & General Mobile Radio Service (GMRS) Walkie Talkies

**EQUIREMENT 8e1:** Explain what the Family Radio Service (FRS) and General Mobile Radio Service (GMRS) are.

Family Radio Service (FRS):

General Mobile Radio Service (GMRS):

**EQUIREMENT 8e1:** Explain how the Family Radio Service (FRS) and General Mobile Radio Service (GMRS) are different from each other.

Notes:



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**EQUIREMENT 8e1:** Explain how the Family Radio Service (FRS) and General Mobile Radio Service (GMRS) are different from other commercial two-way radios.

Notes:

**EQUIREMENT 8e1:** Explain what the Family Radio Service (FRS) and General Mobile Radio Service (GMRS) are different from Citizens Band (CB) & Amateur Radio (HAM).

Notes:



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**EQUIREMENT 8e2a:** Is any type of license needed to use these radios? If so: what kind?

Family Radio Service (FRS)	General Mobile Radio Service (GMRS)
----------------------------	-------------------------------------

**EQUIREMENT 8e2b:** What radio frequencies are used and how is information encoded?

Family Radio Service (FRS)	General Mobile Radio Service (GMRS)
----------------------------	-------------------------------------

**EQUIREMENT 8e2c:** How much power can be used when transmitting?

Family Radio Service (FRS)	General Mobile Radio Service (GMRS)
----------------------------	-------------------------------------



**EQUIREMENT 8e2d:** What type of antenna can be used?

Family Radio Service (FRS)

General Mobile Radio Service (GMRS)

**EQUIREMENT 8e2e:** What is the effective range and what limits it?

Family Radio Service (FRS)

General Mobile Radio Service (GMRS)

**EQUIREMENT 8e2f:** What are common everyday uses for these radios?

Family Radio Service (FRS)

General Mobile Radio Service (GMRS)

**EQUIREMENT 8e2g:** How can these radios be useful in an emergency?

Family Radio Service (FRS)

General Mobile Radio Service (GMRS)



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**EQUIREMENT 8e3:** Use the FRS radios or GMRS walkie talkies with family, friends, or Scouts on a hike, at an event, or in a team game. Discuss what you learned with your counselor.

Notes:

### DO ONE OF THE FOLLOWING (9A or 9B) FOR REQUIREMENT 9

**REQUIREMENT 9a:** Explore careers related to radio. Research one career to learn about the training and education needed, costs, job prospects, salary, job duties, and advancement. With permission of your parent or guardian your research methods may include an internet or library search, an interview with a professional in the field, or a visit to a location where people in this career work or train.

Selected Career Opportunity:

Training Requirements:



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Education Requirements:

Costs:

Job Prospects:

Salary:

Job Duties:

Advancement:



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**REQUIREMENT 9a:** Discuss your findings and career interest with your counselor.

Notes:

**REQUIREMENT 9b:** Explore how you could use radio knowledge and skills to develop a hobby or to serve as a volunteer.

Notes:

**REQUIREMENT 9b:** If possible, with permission of your parent or guardian, interview a radio hobbyist or volunteer.

Notes:



**REQUIREMENT 9b:** Research training and licensing needed, expenses, and organizations that promote or support your objectives.

Training:

Licensing:

Expenses:



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Organizations:

**REQUIREMENT 6b:** Discuss with your counselor what short-term and long-term goals you might have if you pursue this.

Short-Term Goals:

Long-Term Goals: