ARRL
Education and Technology Program
Curriculum Guide

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ARRL
Amateur Radio Education and Technology

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Introduction to
ARRL
Education and Technology Program
Curriculum Guide

Overview: The scope and sequence of any course of study serves as a road map of what is to be taught. The scope and sequence should be in sufficient detail to ensure that the overall learning outcomes are achieved but in-turn flexible enough to meet the learning needs and interests of the individual students. The development of this scope and sequence for The Big Project started first by reviewing the National Science Education Standards (NSES). The NSES defines what science literacy means and then details the content that needs to be taught in our schools so that students can achieve science literacy. With the NSES as a foundation, the overall goal of the Education and Technology Program was reviewed and validated. Armed with this goal and the definition of science literacy as a guide, the definition of wireless technology literacy was developed so that the question, "what do the students need to know and why they need to know it?" could be answered. A literate student can productively participate in their society and meet not only their own needs, but also the needs of their society. The goals of the program and the requirements to achieve literacy then become the compass that keeps all the related learning activities on track. Those iterative learning activities become the scope and sequence.

This scope and sequence therefore is just one suggested road map that teachers and other participants in The Big Project may use to achieve the goals and objectives of their individual programs. There are an infinite number of pathways that teachers and students may take to achieve the end goal and to achieve wireless technology literacy, no one way is best. It is hoped that the following will serve as a guide to help teachers navigate their own route with their students to achieve the success they desire.

Structure: This scope and sequence is designed to be a living document. You will not find this document bound in such a way that it is not easily dissected, taken apart, rearranged, amended, added to, or have pages and sections removed. The preference is to have this document contained in a three ring binder. Hopefully over time this binder will have to be replaced due to wear and tear. As the goals of the Education and Technology Program mature with time and as the definition of wireless technology adjusts to changes in both technology and our society, this scope and sequence will necessarily change to remain a vital and relevant teaching tool. As new roads and pathways are added by new technologies and societal changes, the maps and charts used to navigate through life will need to be updated so that we do not get lost. A bound document serves a purpose, but is not conducive to facilitating and adapting to change.

The open format of this document is intended to encourage the user to adapt it to their needs. Please do so. But also encourage others to improve their programs by keeping them informed of your ideas, progress, successes and failures through the connections offered through The Big Project. Distributing user materials for inclusion in the curriculum materials of others is highly recommended and supported. This ultimately will be what makes this a living document.

Previous editions: The first draft of the Amateur Radio Education and Technology Program curriculum published in 2002 *Radio Lab Handbook* was an excellent beginning, and the authors should be applauded for their outstanding efforts. One major issue surfaced in the review of that curriculum with the current iteration was that it was too narrow in focus. Although the goal of the Education and Technology Program is to facilitate and improve the quality of education through the media of wireless technology, the focus of the early curriculum was on Amateur Radio. And even though the stated goal was not the licensure of students into the Amateur Radio ranks, the early curricula was based on existing licensing manuals and thereby the emphasis on licensing was an insidious theme of the *Radio Lab Handbook*. To the non Amateur Radio enthusiast reader, the curricula was intimidating at best, difficult to coordinate with skeptical school administrations and teachers, and too much…too fast for many students.

Any teacher worth their credentials will throw nothing away; such is the case with the contents of the Radio Lab Handbook. The material is included in this current iteration toward the end of the curricula. This location is not an editorial statement on the quality or value of the material, but the location is a statement on where the content fits into the scope and sequence. Once the student has an understanding of the value of wireless technology, where it fits in today' s world and society, and some of the fundamentals of how it works, in other words once the student has achieved some level of wireless technology literacy…that is the time to encourage them to consider joining the fraternity of Amateur Radio and applying what they have learned. The information contained in the original Radio Lab Handbook also provides an exceptional resource, background and supplementary information that can be used in the preceding core curricula.

Deliberate Ambiguity: The structure of this scope and sequence is in outline form for a purpose. First the outline structure creates an open architecture that facilitates changes, adjustment, and improvements. Second, it encourages individual teachers to innovate and make the curriculum their own through the development of unique lesson plans that meet the needs of their individual students as well as capture the essence of the teacher' s unique talents, interests, and proclivities. Finally, the outline format provides a mechanism for sharing ideas between Project schools. It will serve as the common tread or language that will allow the community to communicate with each other.

Supports State Standards: The teacher is encouraged to use the scope and sequence as a broad set of guidelines or shell to develop their unique course. The major units should provide obvious connections with the major content areas including generic state content standards and themes. Within the units, the objectives should provide obvious connections to multiple strands within the content standards. Finally, the growing list of activities provide hands-on opportunities for students to apply the general learning outcomes of:

1. taking responsibility for one' s own learning.
2. working well with others.
3. engaging in complex thinking and problem solving.
4. recognizing and producing quality performance and quality products.

Summary, and the beginning: So what do you have in your hands? All the answers…no, far from it. A complete recipe to cook up one fascinating course in wireless technology, just add water, heat, and serve…how boring. I hope what you have in your hands is a resource that will help you do what you do best…teach, and teach in a refreshing, captivating way that will bring your students into the world of wireless technology, a journey that will enrich their lives, and our lives. The maps and itinerary for any journey can be provided, it is up to the adventurers to take the first step. So jump, turn the page and let the journey begin.

Mark Spencer, WA8SME
Program Coordinator

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Program Goal

The goal of the Education and Technology Program is to use Amateur Radio as a vehicle to improve the quality of education by providing a curriculum focused on wireless communications. The project emphasizes integration of technology, math, science, geography, language skills and social responsibility within a global society. It also provides a complete Amateur Radio station for schools accepted into the program, coordinating support from local area ham organizations, and other resources.

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Scientific Literacy, Wireless Technology Literacy, and Standards Defined

The National Science Education Standards of 1996 defines scientific literacy as:

Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity.

Scientific literacy means that a person can ask, find, or determine answers to questions derived from curiosity about everyday experiences. It means that a person has the ability to describe, explain, and predict natural phenomena. Scientific literacy entails being able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions. Scientific literacy implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed. A literate citizen should be able to evaluate the quality of scientific information on the basis of its source and the methods used to generate it. Scientific literacy also implies the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately.

In turn The Big Project curriculum focuses on a subset of science, wireless technology. The curriculum is based on the following definition of wireless technology literacy:

A student is considered wireless technology literate when they are:

- **aware of the many types of wireless technology and some of the capabilities and limitations of each.**
- **able to select, operate, and utilize wireless technology to communicate and accurately get the meaning of the intended message conveyed to produce the desire outcome.**
- **able to utilize wireless technology to enrich their lives.**
- **able to adjust the application of the wireless technology, or select alternative means, in response to changing conditions or interference**.

In developing the Science Standards, an important distinction between content standards and curricula was emphasized in the 1996 Science Standards document.

CONTENT AND CURRICULUM. The content of school science is broadly defined to include specific capacities, understandings, and abilities in science. The content standards are not a science curriculum. Curriculum is the way content is delivered: It includes the structure, organization, balance, and presentation of the content in the classroom.

The content standards are not science lessons, classes, courses of study, or school science programs. The components of the science content described can be organized with a variety of emphases and perspectives into many different curricula. The organizational schemes of the content standards are not intended to be used as curricula; instead, the scope, sequence, and coordination of concepts, processes, and topics are left to those who design and implement curricula in science programs.

Curricula often will integrate topics from different subject-matter areas--such as life and physical sciences--from different content standards--such as life sciences and science in personal and social perspectives--and from different school subjects--such as science and mathematics, science and language arts, or science and history.

The Science Standards defines the following vocabulary so that the users of the standards understand the fundamental pillars of science literacy.

KNOWLEDGE AND UNDERSTANDING. Implementing the National Science Education Standards implies the acquisition of scientific knowledge and the development of understanding. Scientific knowledge refers to facts, concepts, principles, laws, theories, and models and can be acquired in many ways. Understanding science requires that an individual integrate a complex structure of many types of knowledge, including the ideas of science, relationships between ideas, reasons for these relationships, ways to use the ideas to explain and predict other natural phenomena, and ways to apply them to many events. Understanding encompasses the ability to use knowledge, and it entails the ability to distinguish between what is and what is not a scientific idea. Developing understanding presupposes that students are actively engaged with the ideas of science and have many experiences with the natural world.

INQUIRY. Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world.

Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations. Students will engage in selected aspects of inquiry as they learn the scientific way of knowing the natural world, but they also should develop the capacity to conduct complete inquiries.

SCIENCE AND TECHNOLOGY. As used in the Standards , the central distinguishing characteristic between science and technology is a difference in goal: The goal of science is to understand the natural world, and the goal of technology is to make modifications in the world to meet human needs. Technology as design is included in the Standards as parallel to science as inquiry.

Technology and science are closely related. A single problem often has both scientific and technological aspects. The need to answer questions in the natural world drives the development of technological products; moreover, technological needs can drive scientific research. And technological products, from pencils to computers, provide tools that promote the understanding of natural phenomena.

The following table provides the correlation between The Big Project curriculum and the Science Standards. Arguably, some of the connections between the individual units may not be a strong or as obvious as others; however, in the overall analysis, there is excellent correlation because the Standards and the definitions of literacy were the litmus test for the curriculum. The intent of this curriculum is to promote wireless technology literacy.

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	Unit 12
Science and Inquiry												
Standard A												
As a result of activities in grades 5-8, all students should develop:												
A-1. Abilities necessary to do scientific inquiry	X		X		X		X	X	X	X	X	X
A-1a. Identify question that can be answered through scientific investigations	X						X	X	X	X		X
A-1b. Design and conduct a scientific investigation	X				X		X	X	X	X		X
A-1c. Use appropriate tools and techniques to gather, analyze, and interpret data	X				X		X	X	X	X		X
A-1d. Develop descriptions, explanations, predictions, and models using evidence	X				X	X	X	X	X	X		X
A-1e. Think critically and logically to make the relationships between evidence and explanations	X				X	X	X	X	X	X		X
A-1f. Recognize and analyze alternative explanations and predications	X				X	X	X	X	X	X	X	X
A-1g. Communicate scientific procedures and explanations.	X		X		X	X	X	X	X	X		X
A-1h. Use mathematics in all aspects of scientific inquiry							X	X	X	X		X
A-2. Understandings about scientific inquiry	X				X	X	X	X	X	X		X

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	Unit 12
Physical Science												
Standard B												
As a result of activities in grades 5-8, all students should develop and understanding of:												
B-1. Properties and changes of properties in matter						X	X	X	X			X
B-2. Motions and forces							X	X	X			X
B-3. Transfer of energy						X	X	X	X			X
Life Science												
Standard C												
As a result of activities in grades 5-8, all students should develop and understanding of:												
C-1. Structure and function in living systems				X						X		X
C-2. Reproduction and heredity												
C-3. Regulation and behavior	X			X	X					X	X	X
C-4. Populations and ecosystems				X								X
C-5. Diversity and adaptations of organisms	X			X	X					X	X	X

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	Unit 12	Unit 13
Earth and Space Science													
Standard D													
As a result of activities in grades 5-8, all students should develop and understanding of:													
D-1. Structure of the earth system							X	X				X	X
D-2. Earth's history							X					X	X
D-3. Earth in the solar system							X					X	X

Science and Technology													
Standard E													
As a result of activities in grades 5-8, all students should develop and understanding of:													
E-1. Abilities of technological design						X		X	X	X		X	X
E-2. Understandings about science and technology	X	X				X		X	X	X		X	X

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	Unit 12
Science in Personal and Social Perspectives												
Standard F												
As a result of activities in grades 5-8, all students should develop and understanding of:												
F-1. Personal health	X			X							X	X
F-2. Populations, resources, and environments	X			X							X	X
F-3. Natural hazards	X	X	X								X	X
F-4. Risks and benefits	X	X	X								X	X
F-5. Science and technology in society	X	X	X	X				X			X	X
History and Nature of Science												
Standard G												
As a result of activities in grades 5-8, all students should develop and understanding of:												
G-1. Science as a human endeavor	X		X	X	X	X		X				X
G-2. Nature of science			X				X					X
G-3. History of science			X			X		X				X

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Unit 1. Our World Without Radio (Wireless) Communications

Objective 1.1. The students will be able to identify those items that they use in their daily lives and within their environment that utilize wireless technology.

Objective 1.2. The student will be able to better appreciate the value and convenience that wireless technology adds to their lives

Activity 1.1: Survey and inventory items around the home, school, and classroom that depend on wireless technology.

Activity 1.2: Survey and inventory items around the home, school, and classroom that could be improved if wireless technology were used.

Activity 1.3: Choose the item within your home, school, or classroom that you use frequently and do not use the wireless capabilities associated with that item. Create a journal of your thoughts about the impact that this restricted use had on your life.

Activity 1.4: Create a journal or log of the hours spent watching TV, using a cordless or cellular phone, listening to CDs, and watching DVDs or VCR movies for one week.

Activity 1.5: Secretly hide the remote controller for the TV/Satellite/Cable/DVD/VCR or headset for the cordless telephone and observe the reaction of your family and friends.

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Unit 2. Career Opportunities Involving Wireless Communications (Why do I need to know about this?)

Objective 2.1: Students will gain an understanding of the importance of wireless technology literacy and how being technology literate is critical to many jobs.

Activity 2.1: Interview two people who have job responsibilities that require them to use wireless technology to perform their jobs. Ask them how they learned how to use the wireless technology required for their jobs. Ask them how they could have been better prepared to learn the skills required to operate the wireless technology.

Activity 2.2: The students participate in field trip visitations to local work places that depend on wireless technology, i.e., police, fire department, taxi dispatch, hospitals, etc. The students develop a list of questions to ask before the visitation.

Activity 2.3: Students participate in guest speaker presentations at their school and write a summary report on the content of the speaker' s remarks particularly emphasizing the comments about wireless technology in the workplace.

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Unit 3. Historical Review of Wireless Technology

Objective 3.1: Students will have a better appreciation of the incremental development of wireless technology and the circumstances underlying major developments of the technology throughout our history.

Objective 3.2: Students will be able to articulate why wireless technology has become such an important technology that influences our daily lives and why this trend will continue in the future.

Activity 3.3: Interview people from older generations about the technology they once used to communicate with friends and family over both long and short distances.

Activity 3.4: Read a story about a major historical event and write a report on how wireless technology had impacted the outcome of the historical event. If wireless technology was not available during the chosen time period of the event, write how wireless technology, if it had been available, would have impacted the event.

Activity 3.5: Develop a time line representation of the major wireless communication advances over history.

Activity 3.6: Collect examples of wireless technology advances and share them with the rest of the class.

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Unit 4. The Definition of Communication (the big picture)

Objective 4.1: The students will understand the importance of communication to our culture and appreciate the complex nature of human communication.

Objective 4.2: The students will be able, with the aide of a communications model, explain what factors can influence, impede, and facilitate effective human communication.

Activity 4.1: In class activity to demonstrate the importance of feedback to human communication. The students are placed in three different communication situations with different forms and amount of feedback. The students will be able to infer the significance of feedback to effective communication.

Activity 4.2: The students will view a video produced in an unknown foreign language and interpret the meaning of the presentation in the video based on the multiple factors of communication.

Activity 4.3: The students will conduct conversations with fellow classmates verbally, in person as well as over wireless technology. The students will prepare a journal of their thoughts and feelings of the quality and accuracy of the two different means of communication.

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Unit 5. Communicating With Codes (symbols)

Objective 5.1: The student will recognize the importance of having an agreed-upon meaning for symbols used in communication.

Objective 5.2: The student will understand the drawbacks and benefits of using codes during communication.

Objective 5.3: The student will appreciate the fundamental concepts involved in developing and utilizing a code used in communication.

Activity 5.1: Students, in pairs, will develop a secret code between them after studying the various codes presented. The students will create and decode messages between the members of the group and then attempt to communicate with other groups using their individually developed group codes.

Activity 5.2: Students will create and decode messages using Morse, Binary, ASCII, and Braille codes. The students will attempt to pass messages via various mediums and determine the most appropriate medium for each code.

Activity 5.3: Students will prepare a conversation message to be shared with a fictitious foreign student, from a non-English speaking country, using internationally recognized "Q" codes.

Activity 5.4: Using wireless technology, students will transmit messages via Morse code.

Activity 5.5: Students will monitor short wave bands for foreign and US broadcast stations. Students will produce a journal of their observations concerning the differences in content and format for these broadcast stations.

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Unit 6. Basic Wireless Station Components

Objective 6.1: Students will be able to develop and drawn a block diagram of a wireless station and identify the major components based in the communication model.

Activity 6.1: Students will survey their community to identify antenna installations. Then they will either speculate or investigate the purpose for each installation.

Activity 6.2: Students will identify the wireless transmitters and receivers in their homes, schools, or classrooms.

Activity 6.3: Students will visit various radio stations within their community and identify the key components of the station.

Activity 6.4: Students will make a string and can communications device and demonstrate its use. Students will identify the major components of their communications device in terms of a wireless station.

Activity 6.5: Students will make a diode/crystal receiver and listen to distant stations. Students will identify the major components of their station.

Activity 6.6: Students will draw parallel diagrams that represent the model of human communication and a representation of the basic components within a radio.

Input ---conversion unit----antenna antenna----conversion unit----output

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Unit 7. Wave Propagation (How does it get from here to there?)

Objective 7.1: Student will better understand the role that wave propagation plays in our world. Students can articulate in their own words the fundamental concept of energy transfer though wave propagation.

Objective 7.2: Students are able to identify different types of waves and wave propagation.

Activity 7.1: Using a wave tank, students will observe simulated ocean wave propagation, diffraction, deflection and transfer of energy.

Activity 7.2: Using a pen laser light and aquarium filled with water, students will demonstrate sky wave, ground wave and line-of-sight wave propagation modes.

Activity 7.3: Using a pen laser light, flash light, and mirrored ball, students will demonstrate how satellites are used to extend the range of line-of-sight wave propagation.

Activity 7.4: Using Inspire equipment, students will collect and analyze very low frequency waves received after the waves propagate by the Whistle mode.

Activity 7.5: Using a pen laser light and classroom chalk dust, students will demonstrate how waves can be reflected by meteor scatter.

Activity 7.6: Using a pen laser light and fiber optic conduction, students will demonstrate how wave ducting propagation occurs.

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Unit 8. Electronics Basics

Objective 8.1: Students will have a better understanding of the basic principal that " moving electrons create a magnetic field, and changing magnetic fields cause electrons to move."

Objective 8.2: Students will be able to define electric current and describe the relationship between the components using Ohm' s Law.

Objective 8.3: Students will be able to identify the basic electronic components: resistors, capacitors, and inductors. Additionally students will be able to explain how each component influences the flow of electric current.

Objective 8.4: Students will be able to explain in their own words how electronic valves (transistors, tubes, integrated circuits) are used to control the flow of electronic current.

Objective 8.5: Students will be able to use exponential math techniques to handle and manipulate the large and small numbers used when working with electronic devices.

Objective 8.6: Students will be able to convert between orders of magnitude within the SI system of numbers.

Objective 8.7: Students will be able to explain in their own words the differences between analog and digital currents.

Activity 8.1: Using a battery, wire, magnetic compass, and voltage sensing device, students will demonstrate the fundamental concept of basic electronics. Students will explain and demonstrate the affect various physical factors have on the flow of electrons (speed of movement, number of turns in a coil, distance between circuit and sensor, battery voltage).

Activity 8.2: Students will demonstrate the relationship between voltage, current and resistance using plastic containers, water, stopwatch, and liquid measurement devices.

Activity 8.3: Using basic electronic instruments (Volt-Ohm-Meter [VOM] and oscilloscope), cork board (perf board), battery, and basic electronic components, students will explore simple circuits.

Activity 8.4: Using an audio signal generator and oscilloscope, students will explore the relationship between wavelength, frequency, and amplitude.

Activity 8.5: Using visual aides, students will convert between units in the SI system for various math problems related to basic electronics.

Activity 8.6: Using large water containers and graduated cylinders, students will explore the wide range of component values that dictate the need to use exponential mathematic to solve basic electronic problems.

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Unit 9. Basic Electronics Building Blocks (how do those components work together?)

Objective 9.1: Students will be able to articulate what each of the 5 basic electronic building blocks do to modify an electric current within a radio to make the radio work.

*Objective 9.2: Students will explore the fundamentals of digital logic circuits that are used in virtually all modern electronic devices including wireless technology.

*Objective 9.3: Students will explore the concept of integrated circuits and understand the value of integrated circuit technology within the contexts of costs, space, and operational savings over equivalent circuits constructed of individual components.

Activity 9.1: Using basic electronic instruments, students will explore pre-prepared circuits of the basic building blocks of a radio and compare how the electric current is modified by each circuit.

- Rectifier
- Oscillator
- Mixer
- Amplifier
- Filter

*Activity 9.2: Using basic digital logic circuits, students will explore the basic logical operations performed by these circuits and construct truth tables for each logical operation.

- NOT
- AND
- OR
- NAND

*Activity 9.3: The students will explore the arrangement of individual electronic components that make up a basic logic operation circuit (NAND gate) and verify that the circuit operation produces the NAND gate truth table. Additionally, students will compare cost and space differences between a NAND gates made of individual components to a NAND gate produced in an integrated circuit.

*Consider for the more advanced students.

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Unit 10. Input/Output Devices (human interaction with radios)

Objective 10.1: Students will be able to explain why wireless technology is a medium used to relay information.

Objective 10.2: Students will be able to identify the unique input and output devices that are required to use wireless technology to convey their intended message.

Activity 10.1: The students will survey their homes, school, and classrooms and identify as many input and output devices that are present and the type of information/messages that would flow through these devices.

Activity 10.2: Students will determine the range limitations and physical proximity restrictions to successfully operate their home garage door opener, cordless telephone, car remote keyless entry, and TV/VCR/DVD/satellite remote control.

Activity 10.3: Students will survey their home, school, and classrooms and determine what limitations are present that make access to these places difficult for people with disabilities (blind, deaf, physically handicapped). Students will invent input/output devices for the physically handicapped to help overcome the identified obstacles.

Activity 10.4: Robotics

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Unit 11. Order Out of Chaos, Rules and Governance of the Air Waves

Objective 11.1: Students will understand the need for rules and standardized operating procedures so that wireless airways are used efficiently.

Objective 11.2: Students will understand the international nature of wireless communication and the need for agreed upon rules and governance of the airwaves.

Activity 11.1: Students will attempt to communicate via two-way radio while someone else is deliberately trying to use the same channel or is causing interference.

Activity 11.2: Students will monitor a local television station while the antenna is disconnected and the reception is poor. Students will produces a journal about the experience.

Activity 11.3: Students participate in on-the-air conversations with other stations observing published rules and procedures. Students will produce a journal about what they observed and what would happen if rules and procedures were not in place.

Activity 11.4: Students will monitor commercial broadcast communication and/or amateur communication and note if required station identification is made.

Activity 11.5: Students will listen to shortwave broadcasts and try to identify as many station locations as possible based on the call signs of the stations.

Activity 11.6: Students will listen in to conversations or broadcasts on shortwave radios and write letters to the station operators asking them for confirmation of the communication observed (QSL Cards).

Activity 11.7: Students will over a period of time, attempt to “ hear all states” on the ham radio frequencies.

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Unit 12. Introduction to Ham Radio (where you can start)

Up to this point in the curriculum, the focus has been on achieving literacy in wireless technology and the use of wireless technology (which includes Amateur Radio) to facilitate student achievement in all areas of the school' s curriculum. Hopefully the students' interest in becoming a ham operator has been stimulated and they desire to take the next step beyond the school and classroom activities and join the group of life long learners who pursue ham radio as a hobby. Or, the teacher may have elected to go right to this point because the goal of his/her program is student enrichment activities.

The premier resource that many teachers and students choose to help instruct and learn the material needed to pass the FCC examination is the American Radio Relay League' s (ARRL)***Now You' re Talking***(NYT). This resource has been cited throughout this curriculum. It is an excellent and comprehensive resource, however it has some limitations that the schoolteachers and students should consider and compensate for. First, the text is organized around the content of the FCC examination and this organizational schema does not necessarily present a logical sequence for learning the content. Secondly, the text does not attempt to put wireless technology within the context of human communication, which is a concept that is fundamental to making the content relevant to many students.

The following is a recommended scope and sequence for a dedicated class that prepares the student to take the exam for the FCC Technician Amateur Radio license. This course is intended to be completed in 8 class days, two instructional hours per class day. Outside study and reading is assumed. Also hands-on demonstrations and activities must be an integral part of the curriculum not only for student success in learning and passing the examination but also for student enjoyment and modeling or mentoring the practical aspects of setting up and operating an Amateur Radio station by experienced operators.

Instructional Day	Unit description	TPB Curriculum Unit	NYT pages numbers.
Day 1	Wireless Technology in Today' s World	Unit 1, 2, 3	
	Why Become a Ham Radio Operator?		vii – viii, 1.3-1.5
	Why is wireless technology an extension of human communication?	Unit 4	

Day 2	Basic Electricity. The vocabulary of electronics and relationships between component parts of electronics (Volts, amps, resistance, power, ohms law, DC/AC)	Unit 8	2.2-2.4, 7.4-7.25, 8.12
	Basics of Radio (Station block diagrams TX, RX, antenna, accessories)	Unit 6	8.1-8.4, 8.10-8.12
Day 3	The Radio Phenomena (How do radio waves get from one place to another?)	Unit 7	3.1-3.9
	Basic Electronics Building Blocks (Rectifier, Oscillator, Amplifier, Mixer, Filter)	Unit 9	8.6-8.8
Day 4	Types of Emissions to Convey Messages	Unit 5, 10	6.2, 6.5-6.6, 6.10, 8.4-8.5, 8.9
	FCC Rules and Regulations Lead to Good Operating Practices	Unit 11, 12	4.1-4.8, 5.1-5.6, 6.1-6.17
Day 5	Setting up a station		4.3, 8.12-8.40
	Safety Considerations (Physical, Electrical, Radio Frequency)		10.1-10.24
	On the air demonstrations		
Day 6	Special Operations	Unit 5	9.1-9.10
	On the air demonstrations		
	Test Preparation		11.1-11.80
Day 7	Practice examinations, review, and questions		ExamWIN Software practice tests
	On the air demonstrations		
Day 8	Advantages of ARRL and club membership		Pages iv, vii
	What do you do after you get your license?		
	Take the final exam		

To help the student to focus on questions that represent the material as presented in the FCC examination, the following questions can be highlighted. Caution, these are not the only questions that may be on the examination and students should study all the

questions. This list of questions should be suggested only for a final review prior to the actual test.

T1 A: 5, 7, 10, 11, 14 B: 2, 6, 8, 11, 15 C: 2, 5, 7 D: 2, 4, 5, 8 E: 3, 4, 8, 10, 11	T2 A: 2, 5, 7, 14, 15 B: 7, 9, 11, 13	T3 A: 3, 4, 5, 10 B: 4, 6, 11, 12	T4 A: 1, 2, 3, 7 B: 2, 8, 10 C: 5, 9, 10	T5 A: 5, 6, 7, 8 B: 2, 3, 4, 8 C: 1, 10, 11, 12
T6 A: 3, 4, 7, 9, 10, 13 B: 1, 4, 7 C: 2, 4, 5, 10	T7 A: A, 9, 20 B: 7, 10, 11, 12 C: 4, 5, 16, 19	T8 A: 3, 5, 8, 12 B: 5, 6, 11, 13, 15, 17 C: 5, 6, 10, 12, 15, 21 D: 2, 3, 9 E: 1, 2, 3, 4, 10 F: 1, 18, 21	T9 A: 6, 10, 13, 14, 20 B: 5, 6, 11, 15	T0 A: 2, 5, 11, 12 B: 3, 7, 10 C: 3, 8, 25, 16, 19 D: 1, 5, 3, 9, 14 E: 3, 6, 7 F: 5, 6, 8, 10

Note: The text material associated with each question can be found by referring to the question pool at the end of *Now You' re Talking*

One technique for final study for the exam that might be used is to have each student take a practice examination either on the computer or on paper. At the end of the exam go over with the class each question missed and explain not only the correct answer but also the material supporting the correct answer. This will highlight the areas that may need additional clarification and instruction while providing confidence-building activities for the students.