

Level	<h1>Introduction to Radio Wave Communication</h1>
Middle School	
Time Required	Lesson Summary
3 Class Periods (45 minutes each)	In this lesson, students will learn about the history of radio spectrum communication technology. They will investigate and experience Morse Code, explore radio history with a digital scavenger hunt, and investigate materials that can block radio waves.
Standards	
<p>NGSS</p> <p>MS.PS4.2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</p> <p>HS.PS4.5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.</p>	
Vocabulary	Objectives
Telegraph Morse Code Regulated Allocation	<ul style="list-style-type: none"> • Students will be able to explain how radio communication has changed throughout history. • Students will be able to determine how waves react with different materials.
Materials	
<ul style="list-style-type: none"> • Copy of FCC “A Short History of Radio” - this can be printed or digital https://transition.fcc.gov/omd/history/radio/documents/short_history.pdf (last accessed 5/15/23) • Can Radio Waves Be Blocked Lab sheets • Radio Spectrum Presentation • History of Radio Waves Scavenger Hunt Student pages • Lab Investigation Supplies: 2 student cell phones per lab group, aluminum foil, metal pot with metal lid and metal lid, felt, packing peanuts, cardboard, tile, plastic box, foam squares, tape • Learn Morse Code site - https://genemecija.github.io/learn-morse-code/ (Last accessed 	

5/15/23)	
Pre-Requisites	
Students should have already learned the electromagnetic spectrum and properties of waves.	
Safety Considerations	
When using headphones while using Learn Morse Code, students should check the volume before beginning so that it is not too loud.	
Pacing Notes	
Day 1: Radio Spectrum Presentation and Learn Morse Code Activity Day 2: Investigate Blocking Radio Waves with Cell Phones Activity and Continue Morse Code Practice if time. Day 3: Radio Wave Scavenger Hunt Activity	
Before the Lesson	
Check to make sure that all of the links work. Be sure that students can access all the materials either digitally or in print. Be sure that Radio Wave blocking investigation materials are cut to sizes large enough to cover a cell phone entirely.	
Assessments	Classroom Instructions
Pre-Activity Assessments	Introduction
Page one of Radio Spectrum Presentation (any words in red are links to videos or webpages). In their notebooks, students will write about how humans have communicated throughout history.	Have the students complete page one of the Radio Spectrum Presentation as today's bell-ringer. Once students have had time to think, have them turn to their table partner and share. Then share out and discuss as a whole group.

Activity Embedded Assessments	Activities
<p>Page two is a review of radio wave properties that have been previously taught. Clarify if students have any questions before moving on.</p> <p>Ask: What do you think it was like to send a message by Morse Code during an emergency?</p> <p>Ask: What is your plan?</p> <p>Ask: Why did you select those materials?</p>	<p>Day 1:</p> <ol style="list-style-type: none"> Continue with direct instruction and discussion using pages 2 – 6 of the presentation to give students background on the history of radio communication. After reviewing page 6, there is a link embedded to go to the Learn Morse Code website. <ol style="list-style-type: none"> When students are on the website they should click the learn tab. Then have the students click “Legend,” to open the Morse Code key. It is best to slow the speed down to WPM at the beginning. Allow students to practice decoding. Once students feel comfortable, allow one partner to wear headphones and try to determine the secret messages their partner is sending them. It is important that students can’t see each other’s screens. In addition, address the importance of sending school appropriate messages before letting students begin. Wrap-up Day 1 with pages 7-9 of the Presentation. Whole class discussion. Feel free to use the questions below or come up with your own. <p>What do we mean by the “Radio Spectrum”? How do we use the Radio Spectrum every day? Who can remind us of what allocation means? What does it mean to regulate the radio spectrum? Why is it important to regulate the spectrum? What do you think would happen if we didn’t have any regulations?</p> <p>Day 2:</p> <ol style="list-style-type: none"> Bell-ringer: Have students complete the bell-ringer, a prerecorded Morse Code message they have to decode. Remind students of what they learned yesterday. One way to do this is to have students talk in small groups about what they learned. After a few minutes go around the room allowing each group to contribute one thing until yesterday’s class is summarized. Investigate Blocking Radio Waves Activity <ol style="list-style-type: none"> Hand out student pages and go over instructions and show students where the materials are located. Either assign groups or allow students to select their own group. It is important that each group have two cell phones so

Ask: What did your group just do?

Ask: Do you have any questions about what you are doing?

Ask: What is one interesting thing you have learned?

Ask: How are waves traveling phones?

Ask: Are sound waves traveling between the phones? Be sure students understand that radio waves are electromagnetic energy and are converted to sound waves in a speaker.

take that into consideration.

c. As students work, circulate through the room and ask the questions in the sidebar to the left.

4. Wrap up the lab

a. Discuss the materials that could block radio waves and why only those materials worked. (Hint: should be aluminum foil and the metal pot with a metal lid - not glass. Conductive metals may reflect or absorb radio waves.)

b. Discuss these things as a class. Please give every group the opportunity to contribute to the conversation. It is important that students are respectful when interacting with each other. Some groups may have had different results with the same materials. That is okay and those groups should be allowed to contribute to the conversation but they need to do it respectfully.

Which materials provided you with the greatest success? Why do you think that is true?

Which materials did not block cell phone signals?

Why weren't those materials useful?

What other materials would you like to try?

Why do you think those are a good idea?

c. Discuss possible benefits of being able to block radio waves.

5. Review Radio Frequency allocation from yesterday and discuss the future of wave use as new technology is developed.

Day 3:

1. Bell-ringer: Have your students use the Learn Morse Code webpage to create a good morning (or afternoon) message. They should take a screenshot of their message and share it with you through your learning management system.

2. History of Radio Communication Scavenger Hunt Activity.
a. Distribute the student pages and go over the directions.
b. Either assign students a partner or allow them to choose their own. This activity can be done independently if you have students who would prefer to not have a partner.
c. Conclusion

Give students a chance to share what they learned during the activity. Consider using the following questions:

	<p>What did you find interesting? Why was that fascinating to you What was boring? Why was it boring? What would you like to learn more about? What questions did the activity cause you to ask?</p> <p>Please be aware that each student may have a different answer to the questions above. Allow them all to contribute to the conversation but be sure they know how to do so respectfully.</p>
Post Activity Assessments	Closure
Complete 3, 2, 1 closure. Be sure to review before tomorrow's class to address questions students may still have.	<p>Have students complete 3, 2, 1 closure on index card (based on last 2 classes)</p> <ul style="list-style-type: none"> ● 3 things they've learned ● 2 things they find interesting ● 1 question they still have
Culturally Inclusive/Responsive Components	
<p>Include women as early radio operators. Jesse Russell was a pioneer in the field of cellular and wireless communications. In 1988, she led the first team from Bell Laboratories to introduce digital cellular technology in the United States.</p> <p>You may want students to spend time researching additional contributions made by women and other minorities.</p> <p>Be careful if you research the history of human communication because there are many stereotypical images of Native Americans using smoke signals. You could address the topic of cultural stereotypes with your students at this time.</p>	
Educator Resources	
<p>Background Information: https://www.wired.com/2009/09/light-and-waves-at-a-basic-level/ (Last accessed 5/15/23)</p> <p>Videos embedded in PowerPoint</p> <p>I. James Clerk Maxwell https://live.myvrspot.com/iframe?v=fYjEwNGVjYjY5MGZjMTJlNzgyM2ZIYjA3YWViZjMxNDk (Last accessed 5/15/23)</p>	

2. Tesla and Marconi Wireless Race

<https://live.myvrspot.com/iframe?v=fZTliMmM0YjA2NWEzZDZkYWYzMjA0Y2QwNmUyNzRjZTk> (Last accessed 5/15/23)

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Below is a list of the lesson titles included in the series. All lessons can be accessed from this web page, <https://superknova.org/educational-resources/>.

Middle School

Introduction to Satellites

Weather Predicting

Introduction to Radio Wave Communication

The Importance of Radio Astronomy

Cubesat Model Building

Understanding FM Radio

Radio Frequency Technology

Who Decides if You Get 5G?

High School

The Uses of Radio Waves and Frequency Allocation

Is Radio Technology Safe?

Diffraction of Radio Waves

Measuring Sea Surface Temperatures with Satellites

Marine Animal Tracking and Bathymetry

How to Design Your Own Crystal Radio

How Radio Waves Changed the World

Simple Wireless Communication

Seeing and Hearing the Invisible

Local Wireless Radio Frequency Communication

Investigating the Internet Connection

The Geometry of Radio Astronomy

Informal

Modeling Radio Astronomy

