Level	Everyday Radio Frequency Technologies
Middle School	

Time Required	Lesson Summary
200 minutes (four 50-minute class periods)	During this lesson, students will investigate the different technologies they may use every day that rely on radio frequencies. Students will brainstorm types of technologies that use these frequencies. After sharing their thoughts, students will work in small groups to research the device and create a presentation. Groups will share their presentations with the class.

Standards

HS-PS4-2 Evaluate questions about the advantages of using a digital transmission and storage of information.

Vocabulary	Objectives
Bluetooth NFC (Near-Field Communication) RFID (Radio-Frequency Identification) UWB (Ultra Wideband)	• Students will better understand the technologies they interact with that rely on radio frequencies. • Students will collaborate with peers to develop and share a presentation of the technology they researched.

Materials

Articles that can be shared with students:

- https://www.pcmag.com/how-to/what-is-ultra-wideband-uwb
- https://www.explainthatstuff.com/rfid.html
- https://www.techtarget.com/searchmobilecomputing/definition/Near-Field-Communication
- https://electronics.howstuffworks.com/bluetooth.htm

Pre-Requisites

Students need to know the bands of the electromagnetic spectrum including the relative frequency and wavelengths of the bands. Students should also be able to understand and use the metric prefixes as EM spectrum wavelengths and frequencies rely heavily on these prefixes.

Safety Considerations

None

Pacing Notes

Day 1 – brainstorming about radio frequency technologies, presentation (including video) on radio technologies

Day 2 – group research

Day 3 – finish research and create presentation

Day 4- presentations

Before the Lesson

Before the lesson, read over the Everyday Radio Technology Frequencies presentation to familiarize yourself with some types of radio frequency technologies. Also, print out or supply a digital copy of the student pages.

Assessments	Classroom Instructions
Pre-Activity Assessments	**Introduction**
	Put up a diagram of the electromagnetic spectrum. Have students answer the following on a small sheet of paper while you take care of administrative tasks. What do you remember about the EM spectrum? Compare and contrast visible light and radio waves.
Activity Embedded Assessments	**Activities**
If students aren't able to explain things about the EM spectrum pause the lesson and reteach this concept.	**Day 1** 1. Have a short whole class discussion over the answers to the introduction questions. Consider asking some of the following questions in addition to your own. What is the electromagnetic spectrum? How does the energy in the spectrum travel from one place to another?

As students share ideas, ask them questions about why they think it uses radio waves and how they could test if it's using radio waves.	What changes as you move right to left across the diagram? What changes as you move left to right across the diagram? 2. Hand out the student video sheet. This page contains questions on each of the videos. It is recommended this is used more as a notes page rather than a paper to collect and grade. 3. Go through the presentation, including the videos, with your students. 4. After the presentation tell students that these were just some of the many ways radio waves are used. Challenge them to come up with a list (without using any research mechanism) of all the uses of radio waves. a. Give students ~ five minutes to brainstorm by themselves. b. Have students share their ideas in one of the following ways: ● Go around the room and have each student talk about their idea(s). ● Have a gallery walk where students display their idea(s) on post it notes or white boards. Students can walk around the room reading ideas and then the class can discuss what they saw. ● Ideas can be shared digitally on a platform like Jam Board or a digital word cloud. Discussions can be held through comments students type into the platform. This method would work best for remote learning. 5. Conclusions – Day 1 a. For an exit ticket, ask students to answer one of the following questions on paper or in digital format: ● How is this device making lives easier or better? ● What do you think a future use of this device could be? ● What safety or security concerns do you have? ● How do you think the device works or how do you think it is constructed? **Day 2** 1. Introduction a. While you are working on administrative tasks have students rank the uses of radio frequencies according to their

	preference as a research topic. 2. Group assignment a. This could be done randomly, by student choice, or by topic interest. Groups of 3 are optimal.
As students work, walk around asking them questions: ● Why do you think radio waves are used instead of another EM wave? ● Why do you think that was invented? ● How do you think that works? ● What problems do users encounter or what could be added to make it better? ● What scientists contributed to this research or invention?	3. Research a. Each group should have a different topic b. Hand out the research guide. Students can use the guide to help them research the device assigned to their group. The guide also has a rubric for their final project. Tell students the items on the guide are suggestions and the back side of the paper can be used for any additional information. c. The group should divide up the research and work independently.
	4. Day 2 Conclusions a. Exit ticket. Students should write down one thing they learned and one thing they still have questions about on a small sheet of paper.
	Day 3
Continue to ask the same questions as yesterday.	1. Student research continues. 2. Presentation creation a. After 20 minutes, inform students that they should begin working on their presentation for Day 4 Presentations can be in a paper format where students make a poster of the information or they can be digital in format where students make a slideshow of their research. 3. Conclusions – Day 3 a. Have students either place their projects in a designated area or upload them to the electronic platform of their choosing.
	Day 4

	1. Give students a few minutes to organize themselves within their groups. 2. Students share their presentations with the class. a. Give each group 5-10 minutes to share their findings and offer time for other students to ask questions. b. For larger classes or classes with limited time, students could also share work as a Gallery Walk. During the Gallery Walk, the poster would be on display and students can walk around and see each one. Have students write one item from each poster as an exit ticket.
Post Activity Assessments	**Closure**
	Have student read the following articles: ● https://www.wikiwand.com/en/Roberto_Landell_de_Moura ● https://lemelson.mit.edu/award-winners/luis-von-ahn Have students write three takeaways from each article and three questions they had about each article.
Culturally Inclusive/Responsive Components	
Have students read about Roberto Landell de Moura, a Brazilian Catholic priest that developed long distance audio transmission, the beginnings of wireless communications. https://www.wikiwand.com/en/Roberto_Landell_de_Moura Have students read and discuss the work of Luis von Ahn. Born in Guatemala, he saw how learning English could lead to more work opportunities. This led him to develop the app Duolingo, helping millions of people worldwide learn new languages. He also invented CAPTCHA, a method to make websites more secure. https://lemelson.mit.edu/award-winners/luis-von-ahn	
Educator Resources	
None	
Acknowledgment	

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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

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