OVERVIEW

Radio Crafters Youth Camp

Overview

Radio Crafters camp is a week-long, half-day camp designed for middle-school aged youth to introduce learners to the concept of radio communication. Through hands-on, team-based activities, papercrafts, and games, youth build their understanding of radio communications by exploring how our devices use radio to communicate with others. Camp ends with a capstone design project where learners create a radio communication system designed to help those affected by a natural disaster in their community.

This camp uses a science storyline approach for the teaching and learning of radio waves and how our devices can send information from one device to another. Rather than view this as a formal classroom NGSS-aligned sequence, this camp brings science, technology and society topics together in a “hearts, minds, and hands” way to inspire curiosity and interest in the phenomena of radio and the technologies that make up radio communication systems.

What is a Storyline?

A science storyline is an approach that starts with an anchoring phenomenon which introduces a compelling problem or scientific question about the world we live in. Unlike other lesson sequences, the storyline approach provides coherent experiences motivated by students’ questions and their own desire to explain the given science phenomenon. In other words, the navigations between learning activities are meant to make sense from the students’ perspective. Each activity, investigation and exploration should help students see and understand they are making progress towards their questions related to the phenomenon at hand. To introduce learners to the anchoring phenomenon for this camp, they watch a video showing the destruction of radio communication systems in Puerto Rico caused by Hurricane Maria in 2017. The video also highlights the difficulties people faced in communicating with others on the U.S. mainland. This provides an ideal context to explore ideas about how radio communication systems function and how to apply these ideas to design solutions that can help people mitigate the impacts of natural disasters.

The Importance of Sense-making

Student sense-making is an important part of the learning process in the science storyline approach. Sense-making happens when students are actively engaged in trying to figure out the way the world works. In this approach, students should be able to state what they are figuring out and why. After coming up with their own initial explanation, model, or some other reasoning to explain why or how the phenomenon under investigation is happening, students assemble pieces of the puzzle (information gathered through investigation and observations) by summarizing and synthesizing new

information about the phenomenon. At each step, students "make sense" of this information gathered by collaborating with one another, sharing ideas, evaluating and critiquing ideas, in order to come to consensus on what they have figured out as a classroom community. Sense-making takes place when students try to develop an explanation of the phenomenon. During this process, the teacher plays the role of the facilitator by asking key questions such as, "What happened?", "What worked?", "What didn't work?", "Why do you think this happened the way that it did?" These kinds of questions support students in figuring out the key science ideas and needed to explain the phenomenon.

Scope and Sequence

Driving Question: *What are radio signals and how can they be used for communication?*	
Big Idea	**What we do and figure out**
Day 1: *Radio signals are invisible. These signals transfer information, but get weaker over distance. Students create initial models to explain why it would be difficult for a person to communicate with a friend on the mainland after the hurricane in Puerto Rico?*	We are introduced to the phenomenon: *Hurricane Maria destroys radio communication systems in Puerto Rico by watching a video/reading a report*. After considering how a person would have difficulties communicating with someone on the United States mainland, we create an initial model using words and drawings that explains *why a person in Puerto Rico had no difficulties communicating with a friend on the mainland **before** the hurricane and why it would be difficult for this person to communicate with their friend on the mainland **after** the hurricane**.** The concepts of coding and decoding in the context of radio communication. We use a radio communication device (the micro:bit) to explore how distance affects the strength of radio signals. We use this information to revise our initial models to show our thinking on how our devices can send pictures or texts to family or friends. We consider how information is sent over long distances and use Morse code to investigate the affordances and limitations of codes used in the past and Through these activities, We figure out the following ideas: ● Radio signals are invisible, they are everywhere and around us at all times, and can be detected. ● The radio signal strength is affected by the distance between the source of the signal (transmitter) and the device receiving the signal (receiver) ● The weather (like hurricanes and other extreme weather) can also affect signal strength.

	• The Morse code is one way to create and send messages (information) over long distances but there are advantages and disadvantages to this type of communication.
Navigation into the next lesson: While Morse code is one way to create and send messages over long distances, we wonder how our wireless devices send different types of information over long distances?	
Day 2: *Radio signals need transmitters that send encoded information, and radio receivers to decode this information and make it useful for us.*	In this lesson, we develop an understanding of how radio communication systems must talk and listen to one another and discuss the role of transmitters and receivers. We consider other kinds of information our devices can send. By thinking about our smartphones and computers, we revise our Wireless Communication Models and wonder how they can send more complex messages. Observing the computer/smartphone screens, we see these screens are made up of smaller parts called pixels used to create digital images. From these observations and the use of the micro:bits, we figure out: • Radio communication systems consists of the encoded message, a transmitter, a receiver and the decoded message • Our digital devices have screens made up of pixels (which are programmable) and can send more complex messages. • We can use binary code to send/receive an image and message to specific devices • We can revise our models of radio communication based on new information gathered
Navigation into the next lesson: We've figured out that radio signals can be used to send complex information (like pictures) from one device to another. This is done by using binary codes to send/ receive an image or message to specific devices. Now we are wondering what is radio anyway? And how can devices located far away communicate with each other?	
Day 3: *Radio signals travel from one antenna within a cell to another antenna. Sensors can encode different types of information from the*	We explore what is a radio signal (wave) and discover the basic difference from AM and FM radio. Considering this new information, we investigate how radio signals travel from place to place over long distances. This motivates us to want to know more about the radio communication problems as a result of the natural disaster that occurred in Puerto Rico. We play a game to identify radio-related technologies used to address radio communication problems as a result of the hurricane in Puerto Rico. We are motivated to explore

environment, such as light, sound, or motion. We can use code to program radio-devices to transmit information they sense around them:	how to code our devices to send radio signals to farther distances. We figure out: ● Radio signals travel from one antenna to another ● Changing the motion of electrons on the transmitting antenna changes the motion of electrons on the receiving antenna ● Our devices can be programmed to gather and receive information from our environment using radio sensors
Navigation into the next lesson: Now that we have figured out how our devices can be coded to sense and respond to things in our environment, and learned how to design radio communication solutions, let's use our new learning to design and create a future solution to a problem that we care about.	
Day 4: *We will use all our ideas about programming radio devices to plan and make a prototype of a radio communication design solution to help those affected by a natural disaster*	In this lesson, we identify natural disasters that can affect people in our community and potential issues/ problems that can result. We work collaboratively with a partner to plan a radio communication design solution to help those affected by the natural disaster that meet the design requirements. We use materials to test our design solutions with the micro:bit while identifying ways to improve the design for the community. Using the results from the tests, final revisions are made to ensure the design solution addresses the identified communication issue in the community. We figure out: ● Radio technologies can be used to protect our community from natural disasters by letting us share information that can help us make critical decisions during an emergency. ● When we connect sensors to radios, they can sense things like changes in weather or motion and send that information to us. This helps us know when something bad might happen and respond quickly, making it easier to stay safe during emergencies.
Navigation: Now that we have identified an issue/ problem affecting people in our community as a result of a natural disaster and have created a radio communication design solution to address those affected, we can revise our designs based on peer feedback and lingering questions we still have.	

Day 5: *We will present our design solutions to our peers and gather feedback, which we will use to refine and improve our designs.*	In this lesson, we will assess our progress in the camp by reviewing the questions from the Driving Question Board that we can now answer. We will also have the opportunity to revise our initial models to reflect our new understanding of how radio communication systems work. Additionally, we will continue refining our design solution. After presenting our design to a peer, we will use their feedback to improve it. Finally, we will have the chance to share our final design with other groups. We figure out: ● Science and engineering learning is about asking questions, defining problems, and exploring ideas to answer those questions and solve those problems. ● There are many ways radio technologies can help us respond to natural disasters.

Norms and Routines

a. **Navigation** from one lesson to another. These are an essential part to help connect ideas to the larger driving question.

b. **Building a consensus** of understanding around the phenomena. Developing a consensus model with learners will lay a foundation for further investigations and activities conducted throughout the class.

c. F**ostering a community of learners.** Be kind, be curious, be safe. Remember to share tools and materials.

Camp At a Glance				
Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**
● Onboarding ● Ice Breaker: Rumors ● Lesson 1: Intro to Radio Communication Systems ○ Phenomenon: Hurricane Maria ○ Initial	● Ice Breaker: What message would you send? ● Revisit Norms ● DQB- What questions do you have? ● Lesson 2: Transmitting & Receiving	● Ice Breaker: Four Corners ● Lesson 3: Programming Sensor Inputs and Outputs ○ How Signals Travel ○ *Whispers in the Wind*	● Optional: *Whispers in the Wind* game ● Revisit Consensus Model & DQB ● Lesson 4: Our Design Solutions ○ Introduce Design	● Opening: What have you figured out ● Lesson 5: Project Work Time ○ Peer Feedback ○ Revise and Finalize

Models ○ Signal Strength Detectives ○ Send Messages with Light: Morse Code Lighthouse Activity ● Navigation: What we figured out ● Clean up	Information ○ Sending a Digital Image Using Code ○ Using Radio Channels ○ Reflection on Our Communication System ● Navigation: What we figured out ● Clean up	○ Using Micro:bit Sensors ● Navigation: What we figured out ● Closing Circle: Decode the Message ● Clean up	Challenge ○ Plan Design Project ● Navigation: Preparation for Day 5 ● Optional Crafting ● Clean up	Design Project ● Complete Post Survey ● Make Your Tik Tok Video

For more information about Radio Crafters camp instructional guides and resources, please contact: Sherry Hsi at shsi@bscs.org