# **Circuit Creators**

Primary Curriculum	Grade 4
Supplemental Curriculum	Grades 3–5+
Notes	Standard unit/refill kit comes with enough materials for 30 students.

### Description

### How can you communicate during an emergency?

Communication and electricity are the lifeblood of technology as we know it. We've come a long way from smoke signals and from computers that take up an entire room! Join Jon as he connects these two concepts to the natural world with stories, songs, and demonstrations.

Using the overarching question of how to communicate during an emergency, students explore properties of communication, circuits, natural hazards, and engineering as they ask themselves: *"What would help my community stay connected during a time of need?"* 

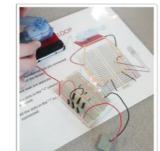
#### Main Investigations

### Code Breakers communication design challenge

Word Light Pattern ብ ብ milkshakes 1 p izza June M<u></u> 1 LUNIA 🏘 🏘 Qu4 want <u>ም</u> ሞ for -Yar m # D٥ ? 6-220 ι two busers

### Code Cards:

Write down your code here and then share it with your friends so they can decode the secret message.





**Circuit Building** 

### **Best Suited For**

• Classroom science instruction

Supplemental program – minimum 5 lessons

\*Lesson = 30–40 min. block, 50% of full unit lessons can be delivered in non-science classes



Number of Lessons\*

Full unit – 25 lessons

### **Overarching Enduring Understanding**

# How are do we communicate (especially with electrical devices) and what are the challenges that arise when communities face challenges?

when communities face challenges?									
Number of Lessons*									
Full unit – 27 lessons									
Supplemental program – minimum 5 lessons									
*Lesson = 30 – 40 min block, 50% of full unit lessons can be delivered in non-science classes									
FLOW OF INSTRUCTION	1								
Investigation: Introduction to	Investigation: Without Words	Investigation:	Investigation:						
Circuit Building (hands-on activity,	(short activity, occurs during	Map It! (research	Communication Challenges						
occurs during weeks 2 & 3)	week 1)	activity, occurs	(summative challenge,						
In parts 1 and 2 of the investigation	Students explore, generate, test	during week 5)	occurs during weeks 6 through 8)						
as students build their circuits they	out, and compare different ways	As preparation for							
must observe and identify different	to communicate/transfer	the summative							
versions of energy—motion, sound,	information without using words	challenge,	After some practice analyzing						
light—and use those observations as	as they are challenged to come	Communication	patterns in the Earth's features,						
evidence in their explanations of how	up with a way to communicate a	Challenges,	students will select and						
energy is transferred throughout the	specific message or idea without	students will	research a place that is prone						
circuit.	using words.	analyze and	to natural disasters. They must						
Students must also qualitatively	Investigation: Code Breaker	interpret data from	connect patterns of the region's						
compare hand speed to the	(design project, occurs during	a variety of maps	features to the natural disaster						
brightness of the LEDs and the sound	week 4)	that include	they are studying.						
(both pitch and volume) of the buzzer.	Marm Un Class discussion on	patterns in Earth's							
In this qualitative hand speed-energy	<i>Warm-Up:</i> Class discussion on	geological features							
correlation investigation, students will	the history of communication and different ways patterns have	and the location of	Students must describe the						
use the evidence and observations	been used to transfer	various natural	communication challenges that						
from their investigations—specifically	information.	disasters.	arise during that natural						
the relationship between increased	information.	Students will	disaster. They must also						
speed of the hand crank to the	Main Activity: Students must	generate a	describe and compare the						
increased brightness of the LED or	decide on a secret message that	composite map of	communication solutions in						
volume of the buzzer—to construct	they want to communicate with	the United States	place to reduce the impact of						
an explanation about the relationship	the following design constraints:	that links	that natural disaster on the						
between hand speed and energy	it must be between 4–7 words	geographical	people who live there.						
produced by the hand crank	long and they must use their	features and							
generator.	circuit equipment to	natural disasters.							
In part 3 of the investigation students	communicate the message.	They will also	Students must design or						
will complete more quantitative	Students must generate a cipher	complete a table	suggest an alternative						
assessment, as they use the	to connect the pattern of lights to	describing natural	communication method and						
multimeter to generate evidence that	the words in their message and	disasters and the	compare it to the solutions						
increase of speed of the hand crank	generate the corresponding	patterns in	already in place.						
relates to an increase in measured	circuit. Students will share their	geological features							
voltage. (Note: This is beyond the	patterns either between groups	that predict where							
stated scope of the NGSS/NYSSLS	or as a class. They will compare	they are most							
standards but can be used to level up	results by assessing how far	likely to occur.							
the activity, to reinforce the concept,	away people could read their								
and/or to increase student	message and suggest ideas to								
confidence.)	improve that.								



# Full Unit

Printed Materials	Trade Books			
<ul> <li>Educator Guide</li> <li>Individual My STEM Stories<sup>™</sup> notebooks</li> <li>Individual My STEM Explorer Notes<sup>™</sup> notebooks</li> <li>Timeline sheets</li> <li>Introductory investigation data recording sheets</li> <li>Laminated instruction sheets</li> </ul>	<image/>			
Provided Equipment & Materials	WORLD			
<ul> <li>Hand crank generators (10)</li> <li>Hand crank wires (10 sets of 2)</li> <li>Breadboard (10)</li> <li>Jumper wires (set of 50)</li> <li>LEDs with resistors (class set)</li> <li>Buzzers (10 at 3–24 V)</li> <li>Multimeter</li> </ul>	<ul> <li>Natural Disasters: Confront the Awesome Power of Nature from Earthquakes and Tsunamis to Hurricanes</li> <li>National Geographic Extreme Weather</li> <li>National Geographic Kids World Atlas</li> </ul>			
Common Equipment & Materials Needed but NOT Provided	Digital Resources			
• NA	<ul> <li>Electronic copies of printed materials1</li> <li>How-To videos for investigations1</li> <li>Easy-to-use links to publicly available videos and other information.</li> </ul>			



Supplemental Unit					
Printed Materials	Trade Books				
<ul> <li>Educator Guide</li> <li>Individual My STEM Stories<sup>™</sup> notebooks</li> <li>Individual My STEM Explorer Notes<sup>™</sup> notebooks</li> <li>Timeline sheets</li> <li>Introductory investigation data recording sheets</li> <li>Laminated instruction sheets</li> </ul>					
Provided Equipment & Materials					
<ul> <li>Hand crank generators (10)</li> <li>Hand crank wires (10 sets of 2)</li> <li>Breadboard (10)</li> <li>Jumper wires (set of 50)</li> <li>LEDs with resistors (class set)</li> <li>Buzzers (10 at 3-24 V)</li> </ul>	<ul> <li>National Geographic Extreme Weather</li> </ul>				
<ul> <li>Multimeter</li> </ul>	<ul> <li>National Geographic Kids World Atlas</li> </ul>				
Common Equipment & Materials Needed but NOT Provided	Digital Resources				
• NA	Electronic copies of printed materials1				
	<ul> <li>How-To videos for investigations1</li> <li>Easy-to-use links to publicly available videos and other information.</li> </ul>				

# **Refill Kit**

### **Printed Materials**

- Educator Guide
- Individual My STEM Stories<sup>™</sup> notebooks
- Individual My STEM Explorer Notes<sup>™</sup> notebooks
- Timeline sheets
- Introductory investigation data recording sheets
- Laminated instruction sheets

### **Provided Equipment & Materials**

- Hand crank generators 2)
- Hand crank wires (2 sets of 2)
- Breadboard (1)
- Jumper wires (set of 10)
- LEDs with resistors (10)
- Buzzers (2 at 3–24 V)

### **Digital Resources**

- Electronic copies of printed materials1
- How-To videos for investigations1
- Easy-to-use links to publicly available videos and other information.



### Parts List

Printed materials	Trade Books		
Educator Guide (1) <sup>1</sup> <i>My STEM Stories</i> <sup>™</sup> notebooks (30) <sup>1</sup> <i>My STEM Explorer Notes</i> <sup>™</sup> notebooks (30) <sup>1</sup> Timeline sheets (1 set) <sup>1</sup> Introductory investigation data recording sheets (30) <sup>1</sup>	РЕРЕЧИТТИЕSS           NATURAL           USASSE           Operation           Operation           Operation           Operation           Operation           Operation           Operation           Operation		
Laminated instruction sheets Provided equipment and materials	WORLD		
Hand crank generators (10) Hand crank wires (10 sets of 2) Breadboard (10)	erent area erent ar		
Jumper wires (set of 50)	Natural Disasters: Confront the Awesome Power of		
LEDs with resistors (class set)	Nature from Earthquakes and Tsunamis to Hurricanes		
Buzzers (10 at 3–24 V)	National Geographic Extreme Weather		
Multimeter	National Geographic Kids World Atlas Digital Resources		
<b>Refill kit includes</b> : 1 Hand crank generator with wires, 2 breadboards, jumper wires, LEDs and 2 buzzers.	How-To videos for investigations <sup>1</sup> Electronic copies of printed materials <sup>1</sup> Curated entrepreneur videos discussing their personal story and technology <sup>1</sup>		

<sup>1</sup>Included in refill kit



## **Overarching Enduring Understanding**

	communities face challe	enges?				
Number of Lessons* Full unit – 27 lessons Supplemental program – minimum 5 lessons *Lesson = 30 – 40 min block, 50% of full unit lessons can be delivered in non-science classes						
FLOW OF INSTRUCTION			-			
<ul> <li>4-PS3-2</li> <li>Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [NYSSLS: Make observations to provide evidence that energy conserved as it is transferred and/or converted from one form to another.]</li> <li>4-PS3-1</li> <li>Use evidence to construct an explanation relating the speed of an object to the energy of that object.</li> </ul>	<ul> <li>4-PS4-3         Generate and compare multiple solutions that use patterns to transfer information.     </li> <li>3-5-ETS1-1         Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.     </li> <li>3-5-ETS1-2         Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.     </li> <li>Investigation: Without Words</li> </ul>	4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.	<ul> <li>4-ESS3-2         Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.         3-5-ETS1-1         Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.         3-5-ETS1-2         Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints or the problem.         Investigation: Communication     </li> </ul>			
Building (hands-on activity, occurs during weeks 2 & 3) In parts 1 and 2 of the investigation as students build their circuits they must observe and identify different versions of energy—motion, sound, light—and use those observations as evidence in their explanations of how energy is transferred throughout the circuit. ( <i>4-PS3-2</i> ) Students must also qualitatively compare hand speed to the brightness of the LEDs and the sound (both pitch and volume) of the buzzer. In this qualitative hand speed- energy correlation investigation, students will use the evidence and observations from their investigations—specifically the relationship between increased speed of the hand crank to the increased brightness of the LED or volume of the buzzer—to construct an explanation about the relationship between hand speed and energy produced by the hand crank generator. ( <i>4-PS3-1</i> ) In part 3 of the investigation students will complete more quantitative assessment, as they use the multimeter to generate evidence that increase of speed of the	(short activity, occurs during week 1) Students explore, generate, test out, and compare different ways to communicate/transfer information without using words (4-PS4-3) as they are challenged to come up with a way to communicate a specific message or idea without using words. Investigation: Code Breaker (design project, occurs during week 4) Warm-Up: Class discussion on the history of communication and different ways patterns have been used to transfer information. (4-PS4- 3) Main Activity: Students must decide on a secret message that they want to communicate with the following design constraints: it must be between 4–7 words long and they must use their circuit equipment to communicate the message. (3-5- ETS1-1) Students must generate a cipher to connect the pattern of lights	It! (research activity, occurs during week 5) As preparation for the summative challenge, Communication Challenges, students will analyze and interpret data from a variety of maps that include patterns in Earth's geological features and the location of various natural disasters. Students will generate a composite map of the United States that links geographical features and natural disasters. They will also complete a table describing natural disasters and the patterns in geological features that predict where they are most	Challenges (summative challenge, occurs during weeks through 8) After some practice analyzing patterns in the Earth's features, students will select and research a place that is prone to natural disasters. They must connect patterns of the region's features to the natural disaster they are studying. (4-ESSS2-2) Students must describe the communication challenges that arise during that natural disaster. They must also describe and compare the communication solutions in place to reduce the impact of that natural disaster on the people who live there. (4-ESSS3-2) Students must design or suggest a alternative communication method and compare it to the solutions already in place. (3-5-ETS1-1, 3-5-ETS1-2)			
hand crank relates to an increase in measured voltage. (Note: This is beyond the stated scope of the NGSS/NYSSLS standards but can be used to level up the activity, to reinforce the concept, and/or to increase student confidence.) (4-PS3-1)	to the words in their message and generate the corresponding circuit. Students will share their patterns either between groups or as a class. They will compare results by assessing how far away people could read their message and suggest ideas to improve that. (4-PS4-3, 3-5- ETS1-2)	likely to occur. (4-ESSS-2)				

