Circuit Creators

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

Description

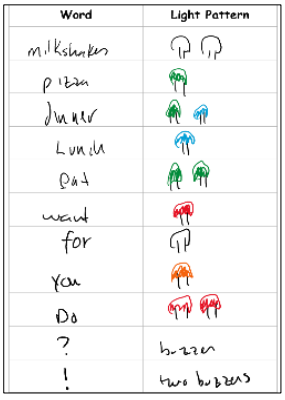
How can you communicate during an emergency?

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

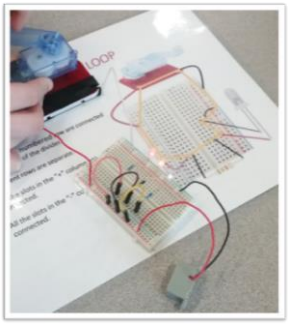
Code Breakers communication design challenge

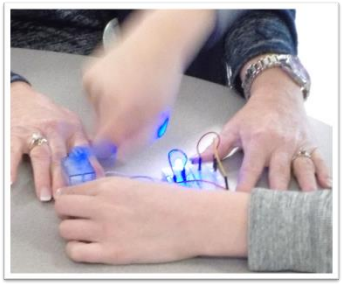


Code Cards:

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

Circuit Building





Number of Lessons*

Full unit – 25 lessons
Supplemental program – minimum 5 lessons

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

Best Suited For

- Classroom science instruction

Overarching Enduring Understanding

How are do we communicate (especially with electrical devices) and what are the challenges that arise 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

Investigation: Introduction to Circuit 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.

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.

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 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.)

Investigation: Without Words (short activity, occurs during week 1)

Students explore, generate, test out, and compare different ways to communicate/transfer information without using words 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.

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. Students must generate a cipher to connect the pattern of lights 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.

Investigation: Map 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 likely to occur.

Investigation: Communication Challenges (summative challenge, occurs during weeks 6 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.

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.

Students must design or suggest an alternative communication method and compare it to the solutions already in place.

Parts List

Full Unit

Printed Materials

- Educator Guide
- Individual *My STEM Stories*™ notebooks
- Individual *My STEM Explorer Notes*™ notebooks
- Timeline sheets
- Introductory investigation data recording sheets
- Laminated instruction sheets

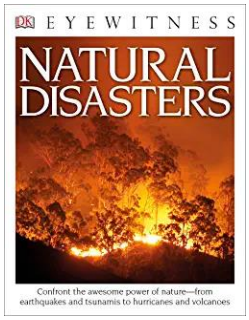
Provided Equipment & Materials

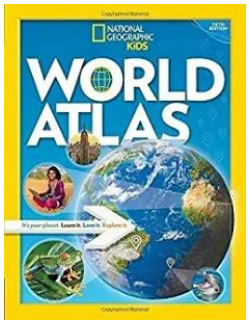
- Hand crank generators (10)
- Hand crank wires (10 sets of 2)
- Breadboard (10)
- Jumper wires (set of 50)
- LEDs with resistors (class set)
- Buzzers (10 at 3–24 V)
- Multimeter

Common Equipment & Materials Needed but NOT Provided

- NA

Trade Books





- *Natural Disasters: Confront the Awesome Power of Nature from Earthquakes and Tsunamis to Hurricanes*
- *National Geographic Extreme Weather*
- *National Geographic Kids World Atlas*

Digital Resources

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

Supplemental Unit

Printed Materials

- Educator Guide
- Individual *My STEM Stories*™ notebooks
- Individual *My STEM Explorer Notes*™ notebooks
- Timeline sheets
- Introductory investigation data recording sheets
- Laminated instruction sheets

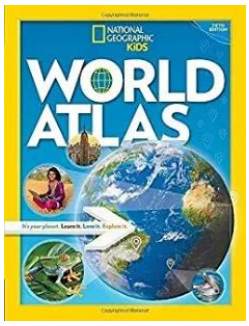
Provided Equipment & Materials

- Hand crank generators (10)
- Hand crank wires (10 sets of 2)
- Breadboard (10)
- Jumper wires (set of 50)
- LEDs with resistors (class set)
- Buzzers (10 at 3–24 V)
- Multimeter

Common Equipment & Materials Needed but NOT Provided

- NA

Trade Books



- *National Geographic Extreme Weather*
- *National Geographic Kids World Atlas*

Digital Resources

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

Refill Kit

Printed Materials

- Educator Guide
- Individual *My STEM Stories*™ notebooks
- Individual *My STEM Explorer Notes*™ notebooks
- Timeline sheets
- Introductory investigation data recording sheets
- Laminated instruction sheets

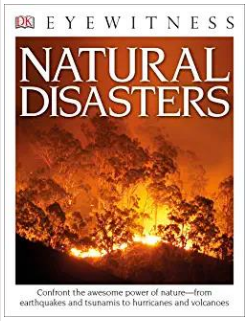
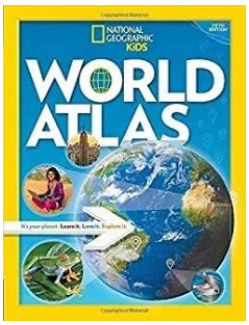
Provided Equipment & Materials

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

[1]*Included in refill kit*

Grade 4

(NGSS Standards: 4-PS3-1,2; 4-PS4-3; 4-ESS2-2; 4-ESS3-2; 3-5-ETS1-1,2)

Overarching Enduring Understanding

How are do we communicate (especially with electrical devices) and what are the challenges that arise 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

4-PS3-2 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.]* **4-PS3-1** Use evidence to construct an explanation relating the speed of an object to the energy of that object.	**4-PS4-3** Generate and compare multiple solutions that use patterns to transfer information. **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 of the problem.	**4-ESS2-2** Analyze and interpret data from maps to describe patterns of Earth's features.	**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 of the problem.
Investigation: Introduction to Circuit 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. *(4-PS3-2)* 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. *(4-PS3-1)* 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 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)*	**Investigation: Without Words (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 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)*	**Investigation: Map 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 likely to occur. *(4-ESSS-2)*	**Investigation: Communication Challenges (summative challenge, occurs during weeks 6 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 an alternative communication method and compare it to the solutions already in place. *(3-5-ETS1-1, 3-5-ETS1-2)*