How To: An adventure in writing and designing circuits

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Introduction

"Ms. Larese, can I share my robot with the class at the end of the day?" It started with a question. One of my students had purchased a robot-making kit and spent her evenings constructing her own moving robot. As the rest of my class watched it move across the classroom, whereby the room was soon filled with squeals and "that's so cool." I couldn't help but think the same and wondered if we could build something in class.

Except. Except that I felt constrained by time… By the amount of other things I had to teach… By the cost of the supplies to purchase kits for my whole class... By the fact that I knew nothing about robots… By the whole idea of developing my own curriculum and then having to explain how it related to what I was supposed to be teaching.

It seemed impossible to reinvent the wheel. So, I decided not to. It became apparent that in order to teach my class about robots and circuits, I needed to become a student again.

As a result, the following curriculum was developed after taking a course about electrical engineering to learn about the key terms, skills, and concepts surrounding basic circuits. Coupled with my own research about circuits and knowledge of teaching 3rd grade, I pulled together resources and lessons to help engage 3rd graders in a lesson about circuits while also meeting the needs of the literacy curriculum.

Overview

To begin my research into developing a lesson that integrated both circuits and writing, I decided to explore the Internet for videos of what other educators were already doing in terms of Circuits education. One such video from “Teachers TV” on the website TES Connect featured a British teacher introducing her students to the different vocabulary, symbols, and concepts related to circuits. Her approach was hands-on, using matching cards, partner work, and utilizing actual equipment.

It began to raise many questions: How could I integrate those same strategies into my own classroom? How could I integrate the concepts learned in my Teachers Institute of Philadelphia (TIP) into the lessons? What activities will get my students to be excited, yet engaged in critical thinking skills and applications of their understanding?

The Answer: Dr. Jorge Santiago-Aviles, Associate Professor of Electrical and Systems Engineering at Penn. In the spring of 2015, Jorge developed a course for the Teacher’s Institute of Philadelphia entitled, “Electronics from Toys to Tools: An Adventure for Future Engineers.” When I first walked into the Detkin Lab at the University of Pennsylvania, I became overwhelmed with mixed feelings. Like a tourist in a foreign country, I was filled with awe, excitement, and utter confusion. Jorge began talking about transistors, protoboards, all the while writing complicated mathematical equations on the board, and describing the functions of the equipment in the lab. Multimeters, power supplies, oscilloscopes… it was a foreign language and I felt that I was in Kindergarten all over again.

I realized in that moment that in order to truly teach my students about circuits and electricity, I needed to resume my role as a student to identify key concepts to understand. For me, that became Ohms Law. I needed to “own it.” In class, we learned that Ohms Law describes the relationships in electricity between three components: Voltage (volts), Current (amps), and Resistance (ohms). The Voltage is the difference in charge between two points. The Current is the rate at which the charge is flowing. The Resistance is the material’s tendency to resist the flow of the charge. The mathematical equation representing this relationship:

$$\mathbf{V = I \times R}$$

Voltage = Current x Resistance

In essence, it’s a garden hose. The Voltage is like the amount of pressure in the hose, the Current is the amount of water, and the Resistance would represent the diameter or distance of the hose’s opening. The amount of Voltage is directly proportional to how much Current and Resistance there is in the system. These unseen forces are difficult for children (and teachers sometimes) to conceptualize. Using an analogy, such as a garden hose, helps students to understand and visualize what is happening.

What I found most fascinating about circuitry is that electrical engineers, in essence, play with Ohms Law like a child plays with building blocks. A child can spend their time constructing whatever they put their mind to it, but are confined and limited to the structure of the block, physical limitations (gravity), and their own creativity. This is much like how an engineer, limited by Ohms Law, are limited only by the materials they have to build with and their own creativity.

For example, one of the greatest tools that we utilized in our course was a protoboard or breadboard. To the average onlooker it seemed like a plastic panel with little holes. To an electrical engineer, a protoboard is a blank sheet of paper waiting for the next greatest novel to be crafted within it. Behind the “little holes” or the visible plane, are actual connections that allow the current to flow through. By adding wires and other elements into the “bus” or series of holes, and connecting it to a power supply, such as a battery or machine, you can create different tools, such as lighting up an LED (light-emitting diode) or buzzer.

Even though the science behind circuitry is complex, for students it can be made simple without taking away higher order thinking or the excitement. A student equipped with the right materials and a sense of curiosity can explore how circuits work. They can understand the history of electronics and make inferences about how they influenced later inventions. Ultimately, they can teach others through their own exploration and writing how to make small circuits work.

Rationale

There is a heavy emphasis in K-3 grades to develop a students reading and writing ability before they end 3rd grade. Students get at least 120 minutes of independent reading, writing, vocabulary, grammar, and spelling instruction daily, on average. In addition, students are constantly being asked to develop their ability to read, write, and respond to texts in other subject areas, such as math and science. This does not always leave teachers the opportunity to have expeditionary or hands-on learning in the classroom. As a result, there is a need for teachers to be intentional in making time to explore and exposing their students to STEM concepts while also meeting the curriculum needs of teaching reading and writing.

Recently, Edutopia published an infographic revealing that “80% of the fastest growing occupations in the United States depend upon mastery of mathematics and scientific knowledge and skills, but students are not currently equipped to satisfy this growing need.” As an educator, this statistic is staggering. It is the duty of teachers everywhere to help children not only be successful in the classroom but to be prepared for the future, especially to be able to be competitive job seekers in technical and scientific fields. This unit of study helps to peak students' interests in Science, Technology, Engineering, & Math (STEM) at an early age, while also meeting the needs of the prescribed curriculum.

Objectives

This unit is intended for students in Grade 3 and can be expanded for use in grade 4. My students spend most of the day in self-contained classrooms, except for 45-minute specialist classes each day, in addition to a 30-minute lunch, and a 15-minute recess. Students take a science class twice a week and work on three large units of study over the course of the year with that teacher, in addition to Art, Music, Gym, and Technology. This unit should be taught in a self-contained classroom.

The objectives of the unit will include the following:

- Explain what a circuit is and key concepts behind circuitry,
- Identify the key steps of building a circuit,
- Understand the need and useful of a circuit in the world around them,
- Encourage students to explore how a circuit works,
- Establish the history and timeline of electricity.

Strategies

This unit will include age-appropriate activities to develop literacy skills and engage students in hands-on science discovery.

- *Whole Group Direct Instruction* – The teacher will be at the front of the classroom explaining to students via a SMART board/ chalkboard / whiteboard.
- *Small Group Instruction* – For students struggling with key concepts, the teacher will meet with them in small groups to review concepts and to differentiate learning.
- *Shared & Independent Work* – Students will have the opportunity to complete tasks working with partners, small groups, and independently.
- *Graphic Organizers* – Teacher-made worksheets using visual representations will help students organize their thinking.
- *Hands-on experiments* – Students will be engaged in activities that allow them to build and represent circuits.
- *Think, pair, share* – Students will have the opportunity to share their thoughts and ideas with partners and with the whole class.
- *Group Centers* – There will be opportunities for students to rotate through centers to further explore circuits.
- Questioning – An ample opportunity for group discussion will help facilitate student understanding. Using Bloom's Taxonomy, teachers can craft key

questions to help expand students' thinking. These questions are crucial to monitor student understanding both in formative and summative assessments:

- Level 1 (Knowledge)
  - What is ____________?
  - How did _________ happen?
  - Match the symbol with the definition.
- Level 2 (Comprehension)
  - Can you explain what is happening?
  - Compare or contrast ____________
  - Draw a picture and include labels that show how this works.
- Level 3 (Application)
  - How would you solve _____ using what you've learned?
  - What would happen if ___________?
  - Experiment with the tools to figure out what is wrong.
- Level 4 (Analysis)
  - What is the relationship between ________ & ________?
  - What is the function of ______________
  - Examine how the different parts function together.
- Level 5 (Synthesis)
  - What changes would you make to solve…
  - How would you adapt __________ to create a different ________?
  - Design a new robot.
- Level 6 (Evaluation)
  - What would you recommend _____?
  - What was it better that _______?
  - Judge whether or not the tool would be an important invention.

Classroom Activities/Lessons

LESSON ONE: Building Background Knowledge

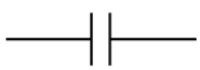
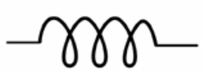
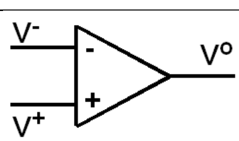
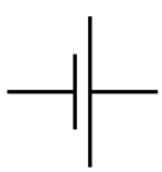
Students will be able to (SWBAT): determine the meaning of key circuit-related vocabulary and symbols… ***in order to (IOT):*** identify the key steps of building a circuit.

Overview: Students will work together in groups to try to match terms, symbols, and definitions related to electricity. Then, teacher will review answers and explicitly teach commonly used terms related to electricity and circuits.

Materials:
Classroom set of Vocabulary Matching Cards
Vocabulary Matching Card Answer Key

Hook: To begin the lesson, the teacher should hold up a symbol that should be instantly recognizable to the students (i.e. stop sign, bathroom sign, etc.). From there, they should hold up other recognizable symbols, some more difficult than others. The connection is that everyone uses symbols to represent important places, things, and even ideas. In this lesson, students will learn about the universal symbols used in electrical engineering that relate to circuits. (5 minutes)

Task: The teacher should distribute a set of vocabulary matching cards to partners or small groups of students. These cards should already be cut, laminated, and bagged for easier distribution. He/she will then explain to the class that they and their partner will have 10 minutes to try to match up the symbols and meanings. Once students begin finishing up matching cards, the teacher will ask students to hold up their matches when prompted for the correct term and explain why they thought that the cards matched.

Symbol	**Electrical Component**	**Purpose**
	Resistor	Drop voltage
	Capacitor	Store charges
	Inductor	Produces magnetic field
	Diode	One way valve for current
	Amplifier	Amplifies voltage
	Battery	Power source

Review: Once all of the cards have been discussed, the teacher will pass out the Answer Key has a resource for students to have in their science folders when describing circuits in their writing. This is an ample time to discuss with students their strategies for figuring out how they matched. These are the universal symbols for each term and are used across the globe to represent each component. Many of the symbols suggest the actual purpose of the electrical component and may help students' understanding of how they interact and relate.

For next time: Review the vocabulary before each lesson so students are equipped with the language to explain what is going on during their experiments. Also, be sure to begin connecting how each component affects the others.

LESSON TWO: ACT THE PART

Students will be able to (SWBAT): explore how a circuit works… ***in order to (IOT):*** identify the key steps of building a circuit.

Overview: Students will become parts of the electrical circuits and will "act out" electricity running through a circuit. Teacher will guide students through the activity.

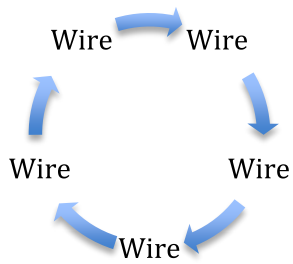
Materials:
*Styrofoam Balls *Paper and pencil *Signs/Labels:

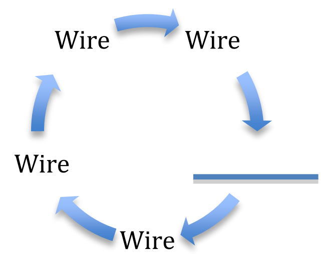
Hook: To begin the lesson, the teacher should review the symbols from the previous lesson. But what do these things look like in real life? The teacher will hold up nerf ball (or another object) and tell students these items will show them how a circuit works.

Task: The teacher will have students create a circle in the classroom. This could be done as a whole class or with a small group of students to demonstrate. The teacher should label the "energy source," "current," and "wires" to tie in the terminology with the role-playing.

Students should pass the ball or "current" around the circle. This is representative of a closed circuit. The teacher will remove a student from the circle and students should try to pass the ball or "current" again, but this time the circuit is open and cannot continue with the missing student.

CLOSED CIRCUIT **OPEN CIRCUIT**





Review: The students should work with a partner to draw an illustration to explain what the difference is between the closed and open circuit. The teacher will have students share out their responses and try to encourage students to use key terms and vocabulary learned during the previous lesson.

For next time: Keep the nerf ball around or encourage students to play closed circuits at recess as a refresher if a student struggles during a lesson.

LESSON THREE: EXPLORING ELECTRICITY

Students will be able to (SWBAT): explore how a circuit works… ***in order to (IOT):*** identify the key steps of building a circuit.

Overview: Students will explore how electricity works by trying light a bulb using a wire and battery. Students will work in small groups and will explain to classmates why or why they were not successful. Teacher will explain to the class how to make their circuits work and check for student understanding.

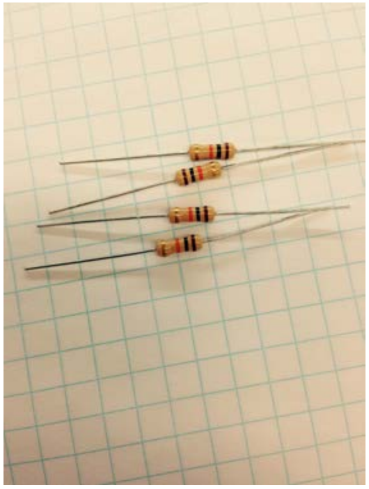
Materials:

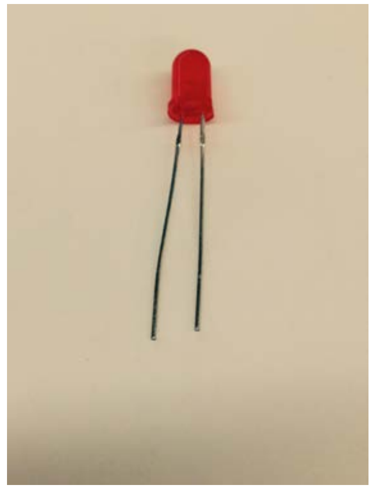
*Light Emitting Diode (LED)

*Battery-operated breadboard

*wires

*transistor





***Transistors** ***Light-emitting diode (LED)**

Hook: Teacher will challenge students to work with partners or small groups to figure out a way to make the light bulb light up. The appeal of this lesson is that there will not be a lot of direct instruction in the beginning from the teacher. The goal is to allow the students to apply what they learned with the nerf simulation and see if they can explore and discover how to make it light up. They, in turn, will teach their classmates how to do it.

Task: Teacher will distribute battery-operated breadboards with pre-set circuits, LED's, and wires. Students will explore moving the wires to make the LED light up. Once groups are able to accomplish this task, they will have to explain how they made it work. After most groups have accomplished the goal, the teacher will review the science behind what the students just accomplished.

Review: Students should complete an "exit ticket" to explain how to light up a light bulb using vocabulary learned in the previous lessons. They may draw a picture and explain how the parts connected.

EXIT TICKET

DIRECTIONS: In the space below, draw a picture of how you (and your partner) were able to turn on the light bulb. Be sure to label each part.

LESSON FOUR: TIMELINES

Students will be able to (SWBAT): put events in sequence ***in order to (IOT):*** establish the history and timeline of electricity.

Overview: Teacher will review how to build a timeline. Students will read and create timelines about the history of electricity.

Materials:
***** Timeline *pre-cut timeline events * glue

Hook: The teacher will post two important events on the board and ask students to talk to a neighbor to decide which event probably came first.

Task: The teacher will share a pre-made timeline with the class; however, there will be events that are missing from the timeline. The teacher will pair students with a partner to help each other decide where on the timeline the events should be place, using clues from other events in history.

Timeline of Electricity

**Content from PBS "American Experience"*

1752	***Lightning Rod***	Benjamin Franklin's experiments help him to conduct lightning.
1844	***Telegraph***	Samuel F.B. Morse sends a telegraph message to Baltimore from Washington, DC.
1858	***Burglar Alarm***	Edwin T. Holmes sells electric burglar alarms.
1875	***Electric Dental Drill***	George F. Green invents the electric dental drill.
1876	***Telephone***	Alexander Graham Bell patents his telephone, built with the help of Thomas A. Watson.
1877	***Phonograph***	Thomas Alva Edison and a team of engineers perfect a system of sound recording and transmission.
1879	***Incandescent Light Bulb***	Thomas Edison perfects an incandescent light bulb.
1882	***Electric Fan***	Dr. Schuyler Skaats Wheeler designs a two-bladed desk fan.
1921	***Wire photo***	Western Union sends an electronically transmitted photograph.
1927	***Television***	Philo Farnsworth demonstrates the first television for potential investors by broadcasting the image of a dollar sign.
1932	***Defibrillator***	Dr. William Bennett Kouwenhoven creates a device for jump-starting the heart using electricity.
1948	***Electric Guitar***	Leo Fender designs the electric guitar.
1972	***Video Game***	Noland Bushnell, the 28 year-old inventor of the video game Pong, will go on to start the video system Atari.
1973	***Cell Phone***	Motorola made the first phone call on a cell phone in New York City.
1983	***PC – Personal Computer***	Time Magazine named Personal Computers "Man of the Year" because of their increasing popularity.
1990	***Hubble Telescope***	The Hubble Telescope goes into orbit around the Earth providing information about space.

Review: Students will have the opportunity to check their timeline for accuracy and the class will share out important events and strategies for how they knew when events occurred. Students should then be able to analyze the relationships between key events on the timelines. Either on the bottom of their time or in a notebook, students should answer key questions such as:

1) What would happen if ___________?
2) What is the relationship between ________ & ________?
3) What more recent inventions should be added to the timeline?

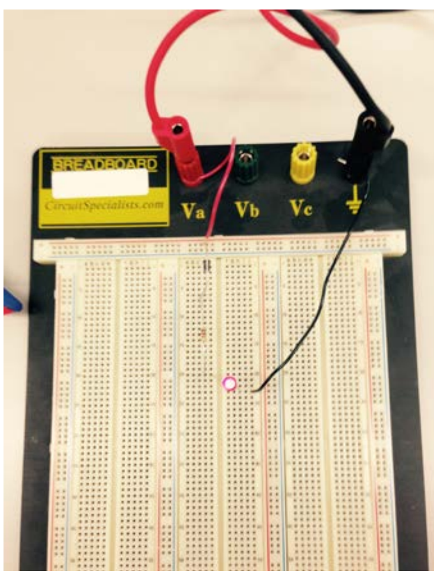
LESSON FIVE: "HOW TO"

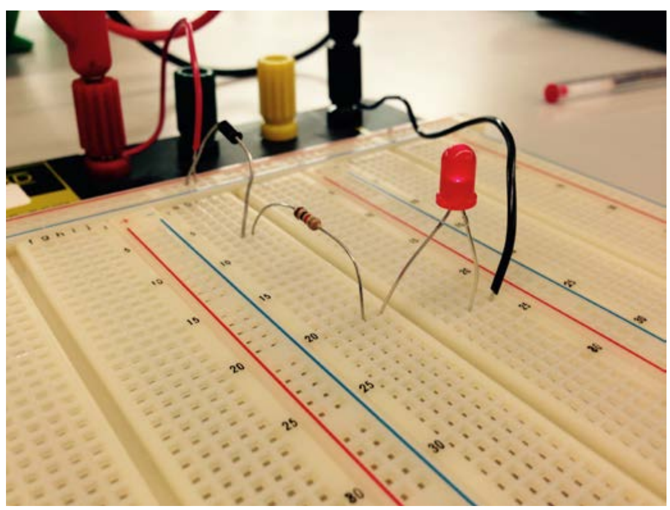
Students will be able to (SWBAT): explore how a circuit works… ***in order to (IOT):*** identify the key steps of building a circuit.

Overview: Students will use insulated wires and battery-operated breadboards to explore how circuits function. Teachers will monitor students' progress, troubleshoot, and explain to students some strategies for using the boards. Moreover, students will create drafts of a how to story to explain to others how to create a closed circuit.

Materials:

*Light Emitting Diode (LED
*Battery-operated breadboard
***Buzzers
*wires
*transistor





***Breadboard with attached wires, transistor, & LED.**

Hook: The teacher will allow students the opportunity to explore the circuits on a breadboard to light up a buzzer and/or LED using different combinations.

Task: Teacher will distribute battery-operated breadboards with no pre-set circuits, LED’s, and wires. Students will explore moving the wires to make different ways to make the LED or buzzer light up. Once groups are able to accomplish this task, they will have to explain how they made it work. After most groups have accomplished the goal, the teacher will review the science behind what the students just accomplished.

Review: Students should complete a graphic organizer to explain how they arranged the wires to achieve the goal of lighting the LED or turning on the buzzer in a step-by-step process. This will help the teacher formulate if students understand the key components of the closed circuit, “own” the key vocabulary, and break down the process into key steps. This may also be done simultaneously while students are working on building the circuit with the help of a partner.

HOW TO: ______________________________

ILLUSTRATION	EXPLANATION
	______________________________ ______________________________ ______________________________
	______________________________ ______________________________ ______________________________
	______________________________ ______________________________ ______________________________
	______________________________ ______________________________ ______________________________

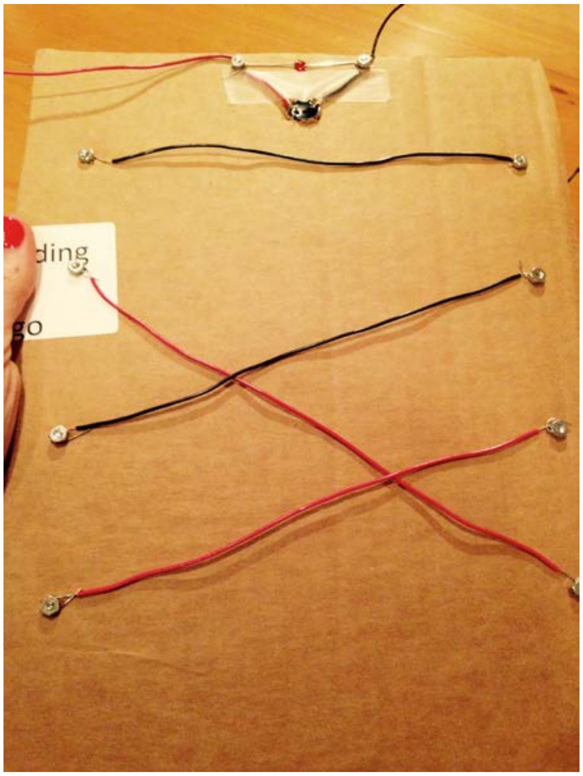
LESSON SIX: QUIZ BOARD

Students will be able to (SWBAT): explore how a circuit works… ***in order to (IOT):*** identify the key steps of building a circuit.

Overview: Each student will take their understanding of how to make a circuit work and use it to design a quiz board that will have one component that will require the use of a circuit. NOTE: This class may need to be broken into 2-3 sessions depending on your class size.

Materials:

*Light Emitting Diode (LED)
*Battery-operated breadboard
*****Buzzers
*Markers
*Tape
*wires
*transistor
*cardboard sheets
*scissors



***Sample back of a quiz board using an LED & buzzer.**

Hook: The teacher will have a fun quiz question with four answer choices on a pre-made quiz board. She will invite a student up to try and find the correct answer, which will in turn light up an LED or turn on a buzzer (or both). Students will create their own quiz question to match 4 pictures with 4 answers.

Task: Teacher will model how to make a quiz board for students, explaining the step-by-step process to build the board. Teacher will distribute supplies to student pairs. Students will explore connecting the wires to nuts and bolts, as well as connecting wires to make the LED or buzzer light up. Once groups have their electrical components attached, they made work on the aesthetic components. After most groups have accomplished the goal, the teacher will review the science behind what the students just accomplished.

Review: Students will have the opportunity to share their quiz boards with classmates and explain the steps that they used to make it work.

LESSON SEVEN: ONLINE DESIGN

Students will be able to (SWBAT): Plan and conduct a simple investigation ***in order to (IOT):*** understand that different questions require different types of investigations.

Overview: Students will need access to a computer in order to access "TryEngineering" at http://tryengineering.org/play-games. These interactive engineering games give students the opportunity to plan and conduct investigations in building without access to supplies at home or in the classroom.

Hook: On a SMART board or a computer, the teacher will introduce students to the site and model a game, as well as set up expectations and rules.

Task: Students will work independently in partners to take part on an interactive game / engineering task.

Review: Students will pair-share their experiences and explain what they built and how. Students will then work with partners or independently to brainstorm their own robot or invention for the future to help others. They should include a picture and a description of how it works and whom it would help.

MY INVENTION

1. What is the name of your invention:
2. What does it do or what is its purpose:
3. How does it work:
4. How will it help others:
5. Why do you want to invent it:

Draw a picture of your idea and label it.

LESSON EIGHT: MINI-BOOK

Students will be able to (SWBAT): explain what a circuit is and identify the key steps of building a circuit… ***in order to (IOT):*** write and publish a how to story related to circuits.

Overview: Students will go through the writing process of an informational text to explain "how to build a circuit" using information gathered in their explorations of circuits. Teachers will guide students through the process.

Hook: Teacher will share will students examples of technical text and how-to stories about science-related items, including invention books. The teacher should encourage each student that they are now a teacher and need to create a book to teach younger students about what they have learned in the unit. They can develop at least 3-5 chapters that may include non-fiction text features and writing to get others interested in STEM!

Task: Students will use their graphic organizers, vocabulary answer key, timelines, invention idea, and other resources to create an informational text about circuits. Students should include a published version of their how-to graphic organizers, descriptions of key timeline events, and even a chapter about inventions that they would like to see create in the future.

Review: There will be a "publishing party" for students to share their texts with classmates and family members.

Bibliography

Reading List:

Martinez, Sylvia Libow, and Gary S. Stager. “Invent to Learn: Making, Tinkering, and Engineering in the Classroom.”

*This book stresses the importance of infusing opportunities for experimentation in the classroom. It also gives tips and ideas for how to begin incorporating meaningful play and STEM initiatives in the classroom.

Platt, Charles. “Make: Electronics (Learning by Discovery).” *Maker Media, Inc.* December 20, 2019.

*This text is a great book for those starting out in their understanding of electronics, with background information as well as small experiments.

Thomas, AnnMarie. “Making Makers: Kids, Tools, and the Future of Innovation.” *Maker Media, Inc.* September 20, 2014.

*This book focuses on the teaching of engineering in the classroom using fun ideas that encourage creativity.

Wilkinson, Karen. “The Art of Tinkering.” *Weldon Owen*. February 4, 2014.

*This book not only entertains the reader with stories of different makers, but also gives ways to begin the art of “tinkering.”

Edutopia. <http://www.edutopia.org/stw-college-career-stem-infographic>

*Edutopia has a plethora of newsworthy and up-to-date statistics and research that fuel teacher interest. This specific infographic (graphic with statistical information) featured facts and information about STEM education and college readiness.

Bloom’s Taxonomy.
<http://www.bloomstaxonomy.org/Blooms%20Taxonomy%20questions.pdf>

*This site refers to the levels of questions to ask students to develop higher order thinking skills, which will help facilitate meaningful discussions, check for understand, and peak students’ interests when learning about electricity and circuits.

Teacher Resources:

Voltage, Current, Resistance, and Ohms Law.
<https://learn.sparkfun.com/tutorials/voltage-current-resistance-and-ohms-law>
*It's crucial that teachers have an understanding of the concepts of voltage, current, resistance, and Ohms Law before teaching this unit. There are a number of great online resources to explain these ideas.

Circuits for Educators. <https://www.tes.co.uk/teaching-resource/teachers-tv-electricity-circuits-6082869>
*This website offers educators to watch circuits education demo lessons in a UK classroom. The teacher leads classroom discussions, models experiments, and gives students the opportunity to explore the content in a structured manner.

PBS Learning Videos:
Lightning.
<http://www.pbslearningmedia.org/resource/phy03.sci.phys.mfw.lightning/lightning/>
*This video illuminates and explains the science behind electrical storms. It is a great video to help visualize the content, yet could also be show to older elementary students.

Electric Girl.
<http://www.pbslearningmedia.org/resource/phy03.sci.phys.mfe.zelectgrl/electric-girl/>
*This video dispels the dangers of electricity, while also encouraging students to explore what electricity is and how it relates to science.

Lemon Battery.
<http://www.pbslearningmedia.org/resource/phy03.sci.phys.mfw.zlemon/experimenting-with-a-lemon-battery/>
*This video explains the lemon experiment that students can try at home or in the classroom. This experiment is a fun way to capture students' attention and draw them into the content of circuits and electricity.

Kid Circuits.
<http://www.pbslearningmedia.org/resource/phy03.sci.phys.mfe.zcircuit/exploring-conductivity-kid-circuits/>
*This specific site not only explains how circuits work, but it also explains what happens when a circuit doesn't work and how to fix it. This deepens students' understanding of circuits and can help them apply their think to every day life.

Electricity Timeline.
<http://www.pbs.org/wgbh/amex/telephone/timeline/timeline_text.html>
*The importance of sequence and understanding the history of electricity/technology advances is highlighted at this PBS site. An abbreviated timeline of major events has been included in this unit for classroom use.

Student Resources:

Cole, Joanna. "The Magic School Bus: Gets Charged." *Scholastic.* January 1, 1999.
*The characters of the popular story series take a field trip through a circuit to understand how it works. This is a great book (and movie) to introduce students to the concept, especially to develop vocabulary for English Language Learners (ELL).

Cole, Joanna. "The Magic School Bus and the Electric Field Trip." *Scholastic.* January 1, 1999.
*The characters of the popular story series take a field trip to the town's local power plant to understand how electricity is generated and how it gets to where it needs to go. This book (and movie) helps students understand the broader scope of electricity and how it relates to building circuits.

Glover, David. "Batteries, Bulbs, and Wires (Young Discoverers)." *Kingfisher.* February 28, 1995. *Constructing Modern Knowledge Press.* May 7, 2013.
*An activity book that teaches, yet also uses pictures to help explain basic and complex ideas.

Electric Circuits. < http://engineering-games.net/for-kids/49/electric-circuits>
*This interactive website not only teaches students some of the key components of a circuit, it allows students to explore how circuits work in common items without having to purchase materials.

TryEngineering. < http://tryengineering.org/play-games>
*Once your students are hooked on becoming engineers, this website allows students to explore different types of engineering competing in game formats.

Standards

The Core Curriculum of the School District of Philadelphia is aligned to the Pennsylvania Academic Standards for Science Education, as well as English Language Arts Standards. These standards include instruction on the following topics: Writing with different purposes, gathering information about observations and measurements in a systematic way, and reading for information. Students will focus on writing informational texts, developing robust vocabulary, and understanding how to build a circuit.

CC.1.2.3.A. Reading Informational Texts
Students read, understand, and respond to informational text—with an emphasis on comprehension, vocabulary acquisition, and making connections among ideas and between texts with a focus on textual evidence.

CC.1.4.3.A. Writing Informational Texts
Write informative/ explanatory texts to examine a topic and convey ideas and information clearly.

This unit of study is also aligned to the National STEM Standards, specifically those that relate to Technology for 3rd graders.

3.2.3.B4. Identify and classify objects and materials that are conductors or insulators of electricity.

3.2.3.B7. Understand that all scientific investigations involve asking and answering questions and comparing the answer with what is already known.

3.2.3.B7. Plan and conduct a simple investigation and understand that different questions require different types of investigations.

3.4.3.C1. Recognize design is a creative process and everyone can design solutions.

3.4.3.C2. Explain why the design process requires creativity and consideration of all ideas.

3.4.3.C3. Recognize that all products and systems are subject to failure; many products and systems can be fixed.