Electricity Basics Elementary School

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Electricity Basics - Elementary

Objectives:

- Through questioning and observing, students will be able to identify the use of electricity in their home, school and community.
- Students will be able to discuss the basic units of electricity (Volts, Amps, Ohms, Watts)
- Through visualizations and discussions students will be able to understand the sources of electricity.
- After completing a hands-on project students will be able to demonstrate how electricity is generated, transmitted and stored.

Materials:

Activity 1 - Lady Liberty

In Kit:

- 1 LED light
- 1 craft stick
- 2 pieces of Maker Tape
- 1 coin cell battery
- 1 binder clip
- Lady Liberty picture
- Glue dot

In Addition:

- Student Instruction Guide

Activity 2 - Community Transmission Map

In Kit:

- 1 wooden cube
- 2 LED lights
- Maker Tape (4 long strips, 5 small strips)
- Map of electricity transmission
- Coin cell battery
- Hand crank motor and handle

In Addition:

- Wooden cubes
- Home Sticker Sheet
- Kits
- Student Instruction Guide

Teacher Tips:

- Be mindful of student airtime during whole group discussions. It is always important that we are diversifying the voices in the room and allowing those who would be otherwise quiet an opportunity to be heard, especially when a conversation could be moving quickly. Offer a time for everyone who wants to share, one comment or connection, before calling on the same student for a second share. Once everyone has been given ample opportunity to contribute at their comfort level with the discussion, then open the floor up for more discussion as time permits!

- Explicitly teaching and then using content vocabulary will support knowledge development for students - especially those where english is their second language and those who potentially struggle with “language

heavy" activities. Front loading content specific vocabulary will allow all students to participate in the conversation. Be intentional and consistent with your use of vocabulary too.

- As students complete each activity, have them put it to the side - keeping their work area clear. By clearing the space it allows the students to focus on the finished product and celebrate their work.

Key Vocabulary:

Electricity - Electricity is the flow of electrical energy. Electricity energy is when tiny particles called electrons are moving through a circuit.
Electrons - negatively charged subatomic particles that jump from atom to atom when electrically charged
Circuit - A closed loop of conductive materials where electricity can flow from the power source through the path to the load back to the power source.
Load - The component using electrical power. Light bulb, motor, appliance
Power source - The source of the electrical energy. Battery, solar panel, power plant, wind turbine
Path - conductive material that allows electrons to flow through.
Power Plant - Place where physical energy is converted into electrical energy.
Transmission - The bulk movement of electrical energy from a generating site to electrical substations and community grids for consumer use.
Generation - The process of transforming a primary energy source (heat or kinetic energy) into electrical energy.
Renewable electricity - Electricity that is generated from a renewable energy source that will never run out, such as wind, solar, water, biomass
Non-renewable electricity - Electricity that is generated from a nonrenewable energy source that will run out, such as coal, oil, natural gas, nuclear.

Lesson Steps:

Introduction & Electricity Discussion - 10 minutes

1. Introduce NYPA team and get to know students ***(Slide 2)***
2. Have students **Think of 3 things that you could not live without that use electricity?** Give students time to share their responses out loud. Encourage them to think of all sorts of different things. ***(Slide 3)***
3. **Define electricity.** Electricity is the flow of electrical energy. Electricity energy is when tiny particles called electrons are moving through a circuit. **(Slide 4)**
4. **Define circuit.** A closed loop or path of conductive material. Where electrons can flow from the power source through the path to the load and back to the power source. The electrons are able to go around the circuit. **(Slide 5)**
5. **Controlling a circuit.** We do things to control electrons in a circuit all day long, we turn on a light switch and make a closed circuit so the electrons can flow to the lights. We plug in our phones to charge and we make a closed circuit for electrons to flow to the battery of the phone.

Activity 1 Build - Lady Liberty Circuit - 20 minutes

6. Introduce EB Activity 1: Let's make our own circuits! We have a dilemma and NYPA needs your help. Lady Liberty's Torch seems to have lost all power and we need your help to build the circuitry that makes it light up the night sky. Before we can fix Lady Liberty, let's go over some basics to make sure we have what we need to resolve this issue and do it safely. We are going to use the materials in our kit to build a circuit to turn the torch back on for Lady Liberty. **(Slide 6)**
    a. Review the safety notes with students **(Slide 7)**
        i. Do not put electrical components in your mouth.
        ii. Always have a load in the circuit.
        iii. Never run a path directly from the battery, back to the battery.
        iv. If anything gets hot, call over the teacher.
    b. Have students clear their workspace. Hand out Activity 1 Kit. Hand out student instruction guide.
    c. Review the materials received in kit with students **(Slide 8 & 9)**
        i. Maker Tape is the path for the circuit, it conducts electricity and is sticky once you peel off the white paper. Teach students how to peel sticky back from Maker Tape. **(Slide 10)**
        ii. LED is the light. Demonstrate that the LED has a shorter leg and longer leg. The shorter leg is negative and the longer leg is positive. Electrons only flow in one direction in these light emitting diodes. The shorter leg always needs to be on the same side of the circuit as the negative (-) side of the battery. And the longer or positive side needs to be connected to the positive (+) side of the battery.
        iii. Battery is the power source - the battery has a + on the positive side
        iv. Binder clip is all metal and acts like a switch.
    d. Have the students follow along with the student guide for creating the circuit with you. ***(Slide 11)***

Sharing & Closing - 10 minutes **(Slide 12, transition point)**

Once the group is complete, call back together and discuss the following questions of wonder.

e. **What parts are required to make an electrical circuit function?** ***(Slide 13)***
A basic circuit needs a power source, load, and a path. Ask students to point to the parts of their circuit as they review each part of the circuit.

f. **How does an electric circuit work?** ***(Slide 14)***
Have a student describe how the circuit they created works. Electrons leave the battery and travel through the path pushing each other to the LED. They then turn the LED light on and then continue to travel through the Maker Tape back to the battery through the clip and around to the battery.

g. How do you think you could measure electricity? ***(Slide 15)***
    i. Electric circuits have pressure & flow. ***(Slide 16)***
        1. Voltage is the pressure, the higher the voltage the more electrons are pushed to move.
        2. The number of electrons flowing through the circuit are called amps. It is the amount of electrons in the circuit. The more amps the more electrons.
        3. When you combine volts and amps you get watts or the measure of power. 100 watt lightbulb takes 100 watts of power.

4. Electrons are pushed by chemical reactions from batteries or pushed out from a generator.

7. Have students clean up workspaces to get ready for a new project. Congratulate them and let them know they have worked to resolve Lady Liberty's torch issue. They are going to be great electrical engineers that NYPA needs. ***(Slide 17)***

Generation & Transmission Discussion - 10 minutes **(Slide 18)**

8. Ask students **Where does electricity come from?**
    a. Allow students to respond with what they think, (they may be off-base responses and that's okay, you will help them understand after this conversation). Electricity is important to our community, and how it is generated is important to NYPA. In activity 1 you used a battery, which generates a little bit of power where they need it. Think about all of the things in our community that use electricity, where does the electricity to power all of those buildings and trains and microwaves and cell phones and lights come from? (***Slide 19)***
    b. **It is generated or made in a Power Plant.** There are many different types of Power Plants around New York State. We have small clean energy plants and hydroelectric plants and solar panel farms and wind turbine farms. ***(Slide 20)***
    c. **If electricity is generated in a power plant, how does it get to us in our home?** It travels along big transmission lines and smaller power lines. Sometimes stopping at energy storage facilities and substations to hold the electricity. ***(Slide 21)***

Activity 2: Build - Community Map - 20 minutes **(Slide 22)**

9. Introduce Activity 2: Let's model what power generation and transmission looks like in our community.
    a. Review the safety notes with students ***(Slide 23)***
    b. Have students clear their workspace. <u>Hand out Activity 2 Kit. Hand out student instruction guide. Hand out 1 block per student.</u>
    c. Review the materials they will receive in their kit. ***(Slide 24)***
        i. There is a map of a community.
        ii. There is a block that will represent a home.
        iii. There is Maker Tape and LEDs and a battery like last time.
        iv. The yellow device is a hand crank motor. If you pop the handle onto the side of your motor you can crank it around and around. When it is being cranked you are pushing electrons and generating electricity. It is the same but different from our battery. It is an energy source that is renewable. The motion of you turning the crank is similar to the motion of wind and water which when harnessed generates a lot of power for New York State. We will include this in our circuit now as a power source.
        v. What two power plants do you see on the map?
    d. Have students follow along with the student guide for creating the circuit on the map with you.

Sharing & Closing - 15 minutes **(Slide 25 - Transition after Build)**

10. Have students clean up quickly, and be prepared to take home any supplies left in their activity bags. Everyone will then come back together to reflect using the slides 26-29.

11. Renewable and Non-renewable Sources (***Slide 26)***
    a. On the community map the blue transmission pathway leads to the clean energy plant which is non-renewable, where the battery will be placed. Explain that non-renewable energy means there is a limited supply of that resource that makes the generator spin, like coal or natural gas, similar to the limited amount of resources in the battery.
    b. On the community map the green transmission pathway leads to the hydroelectric plant which is renewable energy, where the hand-crank generator will be placed. Explain that renewable

energy means we will never run out of that resource that makes the generator spin, like falling water at a hydroelectric plant.

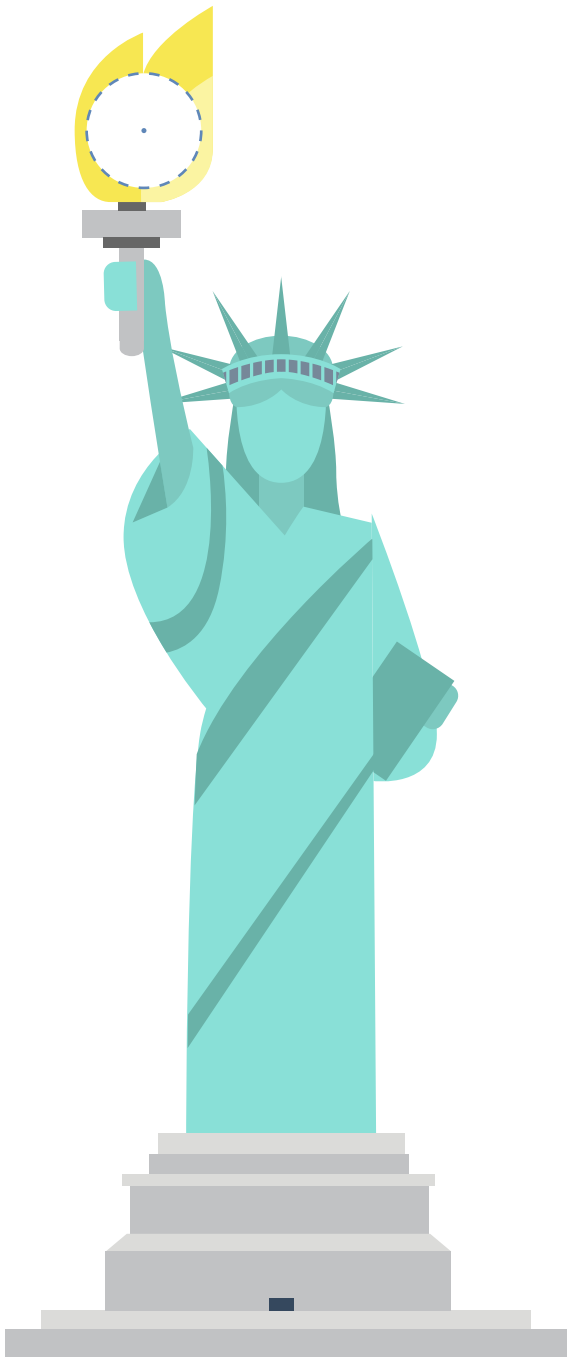
12. How is electrical power created? (***Slide 27 & Slide 28)***
    a. Have students explain and show with their fingers on their map how electricity is generated. Electrical power is created by a generator in a power plant or a hydro plant. A physical force, steam, wind, water pushed a turbine with blades around in a circuit. This spins a shaft inside a generator that excites the electrons and makes them jump. The electrons push each other through transmission lines to substations to your home.

13. How is electricity transmitted? (***Slide 29)***
    a. Have students explain and show with their fingers on their map how electricity is transmitted through Maker Tape pathways.

14. End with a closing thought: ***(Slide 30)***
    a. Today you were NYPA engineers, using both renewable and non-renewable energy to solve a problem and transmit electricity to a home. NYPA has thousands of electricians, engineers and specialists that keep all of our lights on day and night. Everyday the citizens of New York State use more and more electricity in different ways. We need your great minds to keep the lights on and design solutions for our communities now and in the future. What careers do you think you could have with NYPA in the future? What problems do you want to solve?
    b. We really enjoyed being with you today, if you have questions, we can answer them as we wrap up our time together today.

LIGHT THE PATH

STATUE OF LIBERTY



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Electricity Basics 1 Elementary

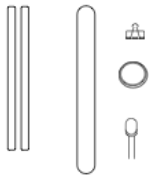
How does a circuit work? Activity 1

Project Overview:

Electricity is a big part of our everyday lives and it is important that we understand how it flows through circuits.

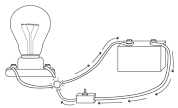
Materials:

- 1 LED light
- 1 craft stick
- 2 pieces of Maker Tape
- 1 coin cell battery
- 1 binder clip
- Lady Liberty picture
- Glue dot



Safety

Coin Cell batteries should not be piled or stored in a way that they could accidentally pile onto each other. Piled coin cell batteries could cause a short circuit.



Short Circuits are very dangerous. They happen when electricity flows without passing through a load such as an LED or fan.

Coin Cell batteries are amazing, but if eaten by humans or animals can become lethal. Never put any type of electrical part in your mouth.

Project Steps:

LED:

1. Take note of which of the legs is positive.
    a. Notice the longer leg is positive (+), the shorter leg is negative (-)
2. Hold the craft stick so it is standing tall.
3. Place the LED on top of the stick with one leg on each side.

Maker Tape:

4. Peel off the white back of one piece of Maker Tape.
5. Use the Maker tape to cover the leg of one LED then run the Maker tape all the way down the craft stick. Repeat on the other side.

Battery:

The coin cell battery has a positive (+) and negative side (-), just like the LED. There is a + on the positive side.

6. Place the battery at the bottom of the craft stick on the same side as the positive (+) leg of the LED. Positive side of the battery should be touching the Maker Tape.

Binder Clip:

7. Squeeze the arms of the binder clip to open the clip. *Watch your fingers!*
8. Clip the battery to the craft stick.
9. The binder clip acts like a switch for your circuit!
    a. It makes a closed circuit and the LED is on.

Lady Liberty:

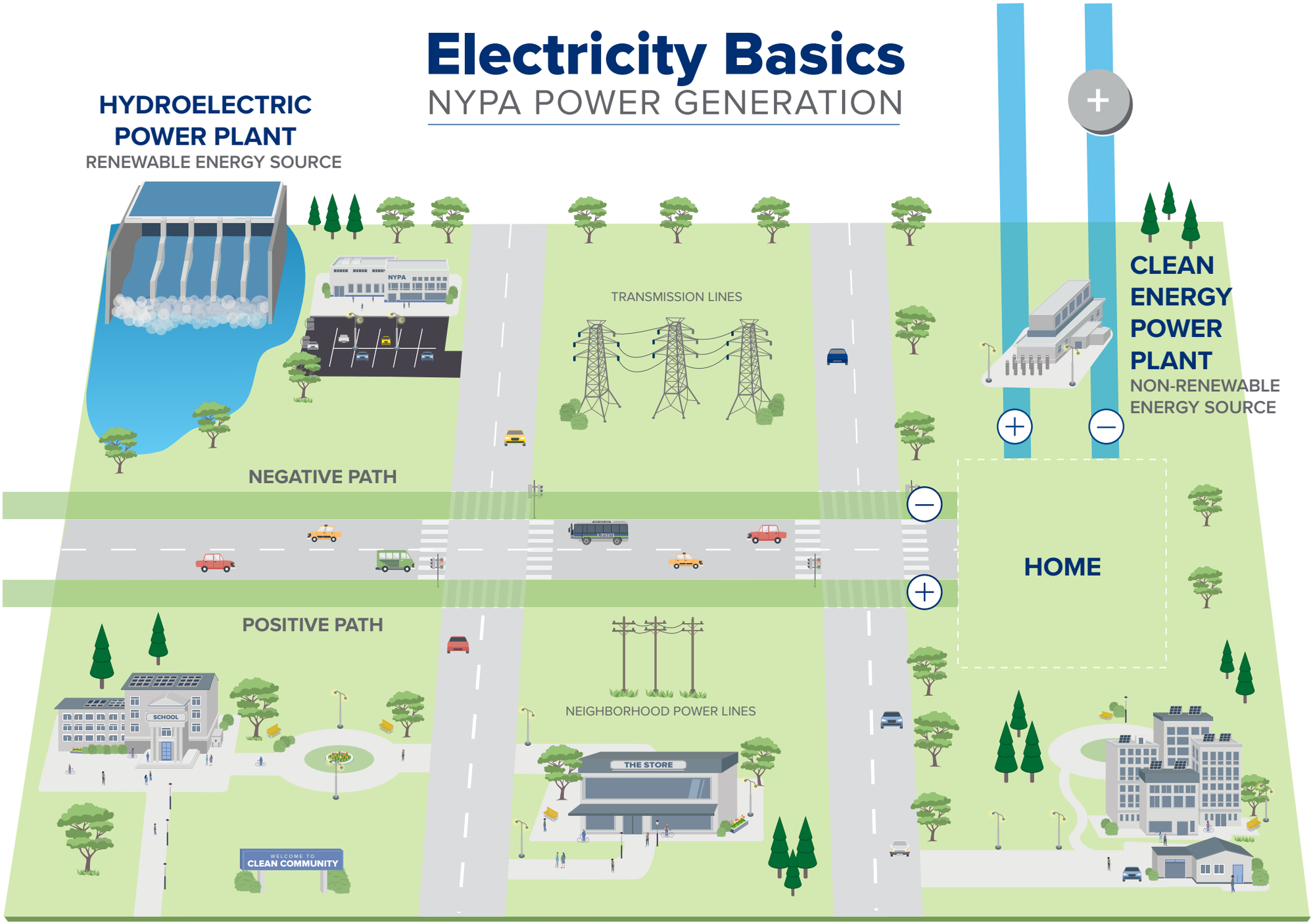
10. Place the circuit behind the Lady Liberty card.
11. Use a glue dot to stick the craft stick to the back of Lady Liberty.

Her torch lights up New York Harbor!

WHYMAKER EDUCATION THROUGH MAKING

Electricity Basics

NYPA POWER GENERATION



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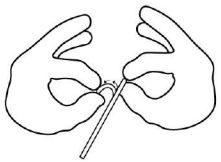
Expert Tips:

- How to peel the paper off the Maker Tape
  Hold the gold side of the Maker Tape facing your thumb and roll your thumb over the top of the Maker Tape and down. The sticky side of the tape will catch on your thumb.



- Maker tape can easily stick to itself. Do not remove all the paper at once. Instead, slowly peel the paper backing while you are securing it to the project.

Questions of Wonder:

- What do you use electricity for?
- How does an electric circuit work?
- What is required to make an electric circuit function?
- Where does electricity come from?
- How is electricity generated?
- How is electricity transmitted?
- How is electricity measured?
- How does electricity play a role in your future?
- What jobs do you think people have that work with electricity?

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Electricity Basics 2 Elementary

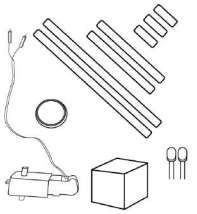
Community Electricity Transmission Activity 2

Project Overview:

Electricity is important to our community. Let's learn how it is generated and how it is transmitted to power everything in our lives. In this project we will use both renewable and non-renewable sources to power the lights in our home. Just like NYPA we are working to use renewable sources to power our communities.

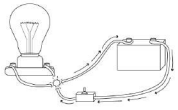
Materials:

- 1 wooden cube (home)
- 2 LED lights
- Maker Tape (4 long strips, 5 small strips)
- Map of electricity transmission within the community
- Coin cell battery (*non-renewable*)
- Hand crank motor (*renewable*) & Handle



Safety

Coin Cell batteries should not be piled or stored in a way that they could accidentally pile onto each other. Piled coin cell batteries could cause a short circuit.



Short Circuits are very dangerous. They happen when electricity flows without passing through a load such as an LED or fan.

Coin Cell batteries are amazing, but if eaten by humans or animals can become lethal. Never put any type of battery in your mouth.

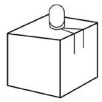
Project Steps

Home: Cube & LEDs

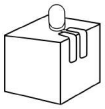
Remember the longer leg of the LED is positive (+), the shorter leg is negative (-). The cube symbolizes your home.

1. Separate the legs of the LED. Bend the LED legs to create "knees" so the LED can "sit" on top of the cube with the legs hanging off the side of the cube. Sit 1 LED, so the legs are aligned with the blue side of the cube.

   a. Use 2 small strips of Maker Tape to secure the legs of the LED by sticking the tape vertically along the side of the cube - one strip per leg, do not let tape overlap.



2. Secure the other LED on the green side repeating the same steps.



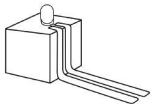
3. Place the cube on the map where it says "*home*." Be sure to match the green side of the cube with the green pathway and the blue side of the cube with the blue pathway.
4. Use the stickers to decorate your home later.

Transmission Lines: Maker Tape

Create the transmission lines by following the pathways on the map.

Make sure none of the transmission lines overlap!

Non-Renewable Energy Source (blue pathway)



5. The 2 longer strips of Maker Tape will be used to connect the LED to the transmission lines. Start by sticking the Maker Tape to cover some of the smaller tape on the cube, making a connection. Then continue down the cube and along the blue transmission line. This will secure the cube to the paper and build the path for the circuit. Do this for both blue paths. Make sure the parallel paths do not touch each other.

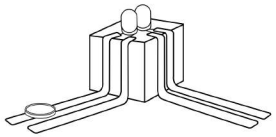
Renewable Energy Source (green pathway)

6. Using the other 2 longer strips of Maker Tape, one for each path. Repeat the step above to create the pathways for the green transmission lines. Make sure the parallel paths do not touch each other. **Do not secure the ends of the Maker Tape completely to paper on the green transmission lines - the loose ends of tape are needed to attach the hand crank.**

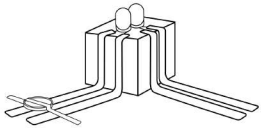
Power Sources: Battery & Hand Crank

Non-Renewable Power Source (Battery)

Use the last small strip of Maker Tape to create the switch for the battery.



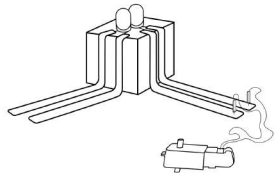
7. Place battery negative (-) side down, on top of the pathway extending from the negative (-) or shorter leg of the LED.
8. Complete this circuit by sticking Maker Tape across the top of the positive side (+) of the battery and running it across to the positive pathway.



9. The battery will not be fully attached to the paper and that's okay.

Renewable Power Source (Hand Crank)

10. Secure the metal tip of the red wire from the hand crank to the positive (+) pathway of your green transmission line using the free end of the Maker Tape.
11. Repeat the step above for the black wire, on the negative (-) path.



12. Attach the handle to the white shaft coming out of the side of the yellow motor.

The hand crank will need your energy to light the LED, just like a hydroelectric plant needs flowing water and a wind turbine needs blowing wind.