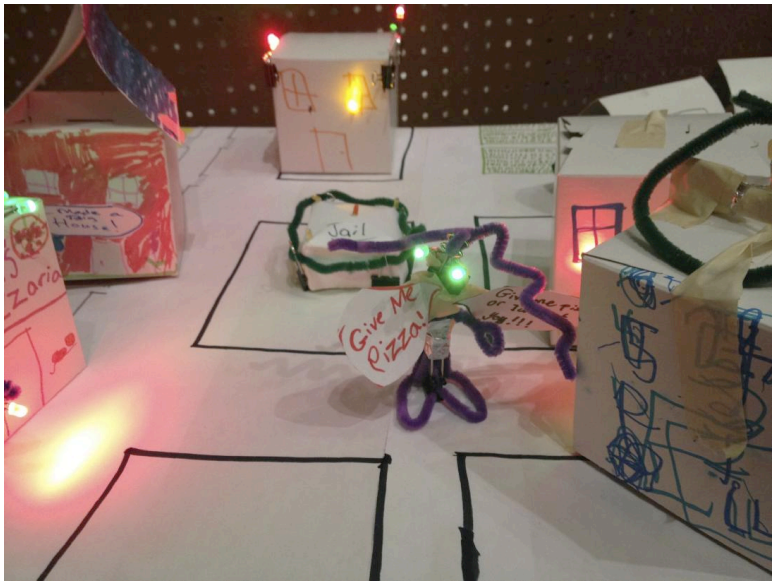
HAPPY CITY

Duration: 45-60 minutes
Institution: NYSCI
Skill level/Age Level: 7 and up
Group size: 2-25 children

INTRODUCTION

Happy City is a design activity exploring circuits, conductivity, and community. Kids add things to a city model to make it a happier place, using LEDs and batteries (optionally, motors too) to make their creations do something. Since the kids decide for themselves what would make the city happy, they get really invested in what they're making and how it will work. This kind of problem-defining and problem solving is at the heart of what engineering design is. The activity can inspire great conversations about electricity or community.



MATERIALS AND TOOLS

Essential Materials:

- LEDs, assorted colors, plan for 4-6 per person
- 3V coin cell batteries, plan for about 5 batteries per person
- Aluminum foil folded into wires, about 5 per person
- Masking tape
- Paper clips (especially helpful if you use motors)
- Lightweight cardboard cut in strips, cereal boxes, etc.
- A wide variety of materials that can be cut, shaped, and connected (we use index cards, straws, and pipe cleaners. Other potentially useful materials are popsicles sticks, wire, felt, etc.)

New York Hall of Science · 47-01 111th Street · Queens, NY 11368 · 718-699-0005 · www.nysci.org

- Scissors
- Hole punches
- Markers

Optional Materials:

- Wire
- Large sheets of paper to make a city map
- Low-voltage hobby motors that will work with 3V batteries, and that have. Here's a source and part number: http://www.jameco.com Part No. 231917

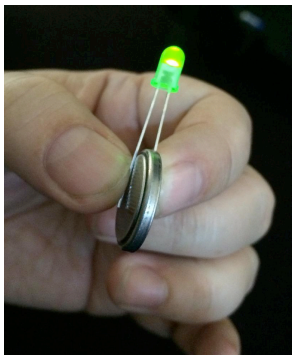
SET UP

- Put materials in the middle of the tables, leaving space for children to work. It's best if materials are in bins, buckets, or dishes
- Set up one table to use as the city. It's helpful to add a city map that shows streets, parks, rivers, etc.

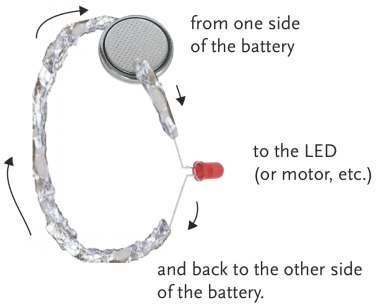
HOW TO OR STEP-BY-STEP

1. Introduce the activity
    a. Imagine yourself walking down the street, through the park, etc. What do you see? What is your favorite thing to do? What things could you add to your neighborhood involving lights that would make it a happier place?
        i) Elicit a variety of responses from kids. If you're using motors, you can encourage them to think about adding motion to their creations as well.
2. Introduce the materials and talk about circuits
    a. Take a look at the coin battery. There are two sides: one positive and the other negative. There will be a plus sign on the positive side.

    b. Look at the LED. Note how one leg is longer than the other. The long leg is positive, and the short leg is negative.
    c. If you connect the legs of the LED to either side of the battery, you form a loop for the electricity to follow—from the negative side of the batter, through the LED, and back to the positive side of the batter. That's what a circuit is—a loop. Note that LEDs only work when you connect the positive leg to the positive side of the batter. So if it doesn't light up, just switch it around. You can use tape to hold it all together.



A circuit is a a loop:



d. A switch is just anything that will break and then re-connect the loop. For instance, if the LED leg doesn't touch the foil unless it's pressed tightly, that's a simple switch. When the LED doesn't touch the battery, the loop is broken and the electricity doesn't flow. When the LED is pressed to the battery, the loop is closed, and the electricity will flow to the LED and make it light up.
e. Electricity will flow though any material that's conductive, like aluminum foil. You can use aluminum foil to put the LEDs further away from the batter. An easy way to attach the foil to the LED is to bend the LED leg over the foil, and then tape them together.

3. Help the students to build their creations, encouraging them to experiment with the materials, and look to what others are doing for ideas and help.
4. Have them add their creations to the city model, explain what they made, how it works, and what it adds to the city.

FACILITATION PROMPTS AND QUESTIONS

- Encourage older kids to consider ways they want their circuits to respond when something happens. For instance, do they want to make a town sign that lights up when you press it? They can make a switch—a piece of the circuit that only closes when you press on it.
- Be on the lookout for short circuits—loops that connect one side of the batter to the other without going through the LED or the motor. This can happen when aluminum foil strips touch each other, or when something metal touches the negative side of the batter and the edges of the batter. When there's a short circuit, the battery gets hot and drains quickly, losing the ability to light up an LED. You can use tape to insulate one piece of foil from another, if you need.
- It helps to build the circuit bit-by-bit, constantly testing that it will work. And you don't need to over-tape. Sometimes the circuits become unconnected by overzealous taping.
- If you use motors that look like this, you need to connect each side of the battery to one of the two tabs on the back. It's easier to do if you treading a paperclip, though the hold on each of the tabs. Then you can just connect to the paperclips.

- While kids are building, ask them to talk about why their creations will make the city a happy place. How will everything work together?
- Encourage detailed answers and rich story telling. As you listen, feel free to introduce aspects of the setting that solutions will have to negotiate with their creations.

MATERIALS SOURCES

- LEDs—we use red, yellow, and green. Since sourcing cheap LEDs can sometimes be confusing, here's a source with some part numbers that might work: http://www.jameco.com Red-part no. 697522, Yellow-part no. 697549, Green-part no. 697531
- Coin Cell batteries: a good, cheap source is http://www.cheap-batteries.com/cn.html Usually you will buy CR-2032 batteries, but you can also use 2025, 2016, 2012. The first two numbers tell you the diameter of the battery, and the second two tell you the height. All of them are 3V batteries. So those other seizes are the same diameter, just thinner.
- Low-voltage hobby motors: choose a voltage that will work with 3V or less, and that has good tabs to connect to. For example http://wwwjameco.com Part no. 231917.
- Aluminum foil folded into wires; On method of foil wires can be found at http://www.raftsac.org/readpdf?isis=63 . Another method is to roll aluminum foil two times around a pencil and tear away extra foil. Pull out the pencil and flatten the tube. If you want, fold the wire in half lengthwise to make it thinner.

MORE INFORMATION

Here is a quick video about Hacking an audio greeting card with an explanation of circuits and switches
https://www.youtube.com/watch?v=wPFk7VzDpUc

KEYWORDS (STYLE: HEADING 1)

- Electricity
- Circuits
- Energy
- Engineering