Day 4
Circuits Party

Overview:

This activity is meant to combine the knowledge and understanding of circuits that the students learned in the Soft Circuits and Paper Circuits activities, and add switches to the mix. This will increase the complexity and functionality of their circuits. They will be prompted to explore, play and tinker with all the materials they have used so far to create a project of their choosing.

Materials

Prepare all the materials from Soft Circuits and Paper Circuits Activity.

Helpful Hint: We recommend that you place them in bins at a materials table away from the work area. This way, students can go the materials table whenever needed and return with the perfect materials for their project.

Introduction/Discussion

What have we done so far? What projects have we made? What tools have we used? What materials have we used? What has been your favorite activity/project/material/tool? What have we learned about circuits? How does a circuit work? What materials do you need to make a circuit? What were some of the challenges? How did you overcome them?

Helpful Hint: Have the students bring their projects to the discussion. This will help them visually share what they have learned and what they have done.

Today we are going to take everything we have learned about circuits and apply them to our own projects. You can use any or all of the materials and tools we have used so far in this program to add to, hack and modify existing projects, create a new project with an assortment of materials, or all of the above. Students should use at least two LEDs in the project, as well as add a switch.

Introduce Switches: *What is a switch? Why do we use switches? How do we make a switch in our circuit?* Have a variety of samples of soft circuits and paper circuits that have switches. This will help them visualize what a switch made with simple materials looks and how it can be integrated into a circuit.

Start Making

This is meant to be a student-driven creative project in which they can combine the possibilities of all they have learned into a new project. Allow the students to take some time to think of what they may want to make. Have them list ideas, diagram potential projects, and draw circuit diagrams in their journals. They can even add sewn or paper circuits to their science journals!

1. At each table students should discuss what they might want to make with each other. They can share ideas and even combine resources to make a collaborative project. When students at the New York Hall of Science do this, we always encourage open exploration of materials and trial and error. We also like to ask, "Will you share the project when it is finished? Who will be taking it home?"
2. Once the students are finished designing and sketching their projects, they can go to the materials table to collect their materials.
3. Make time at the end of the activity for the students to share their projects with each other. You could also have a "gallery walk" where everyone walks around the room to see each project.

   Helpful Hint: This should be a student-driven project. The facilitation should be "hands off" and is meant to guide the project as it unfolds. Make sure to remind them of technical aspects of making circuits such as short circuits, polarity of battery and LED, as well as encourage them to experiment with materials.

   If some students are struggling with what to make and it may be hindering their progress, you can always offer some focused challenge projects to help get the creative juices flowing.

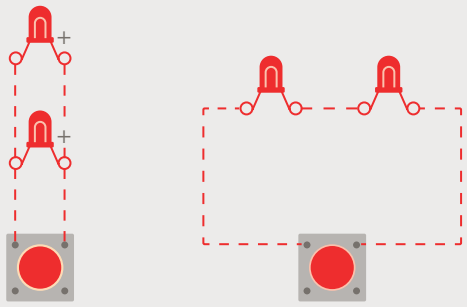
Here are some projects we use:

- Paper lanterns.
- LED card for a special occasion.
- Make some light-up art for your wall.
- Modify or build off of the previous projects by redesigning and adding a switch.
- Light-up bookmarks.
- Bling out your science journal. Add LEDs, switches and conductive tape to your journal!

Trust your hands! We have found once students start making with their hands, the rest falls into place. Starting is often the hardest part.

Material Tips

Tearing Tape: It is easier and less time consuming to tear the masking tape and conductive tape. Demonstrate how easily tape can be torn or removed from paper and cardboard. This will help with iterating on their project designs.



Basic Parallel Circuit **Series Circuit**

Using multiple LEDs, you will have to make a series or a parallel circuit. It's easier to use a parallel circuit. If you use a series circuit, you may have to add an additional battery *(just stack it on top of the first battery)*.

Documentation

Encourage students to take photos of their projects and videos sharing their work.

Helpful Hint: LEDs come in all shapes, sizes and colors! Every LED has different power requirements, and they will often shine brighter than others. Experiment with different colors and see what happens.

Material Tips and Variations

Conductive Tape: 5mm copper tape is the standard size for paper circuits, but not all copper tape is created equal. Sometimes it is only conductive on the non-adhesive side. We recommend testing both sides of the copper tape to make sure it is conductive on both sides.

Aluminum tape is another option and is also easy to find at most hardware stores, but not as conductive as copper tape. You can also use aluminum foil and glue sticks to create your circuits.

Conductive cloth fabric tape is easy to work with, sticks to paper and fabric, isn't as sharp as copper tape, and can be peeled up easily for reapplication. However, it is harder to find and may be more expensive if not bought in bulk. It also must be cut with scissors.

LEDs: LED stands for "light emitting diode." It is smaller and more efficient than regular light bulbs.

Basic LEDs can come in smaller (3mm) or larger (10mm "gum drop") sizes as well as squares and rectangles. All of these will work with simple circuits.

Another type of LED you can use with most of these projects is called SMD LED. SMD stands for "surface mount device" and they are tiny! SMD LEDs are great to use for advanced paper circuits because of their size and ability to be tucked into tight spaces. To use them, just tape them down onto your circuit with scotch tape. It helps to get the SMD LED on the scotch tape first and then position it where it needs to be on the circuit.

Science Journal Prompts

- What did you make today? Explain your process. What did you do first?
- How did you come up with the idea for your project? What inspired you?
- What materials did you use?
- What do you like about your project?
- What might you change if you had more time, or could make it again?

Facilitator Debrief Prompts

- Was the open-ended nature of this activity more or less challenging for the students?
- What conversations about iteration and changes did you hear?
- Were there any similarities in designs or solutions between learners? How did these similarities lead to iteration?
- What kinds of facilitation support did you provide? What would be helpful in further building the creative process with students?
- What knowledge or ideas did you notice that were carried over from other projects?
- Have you noticed any changes in the ways learners manage disappointment or problem solving? What do you think contributed to this?