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Two Bit Circus

Abstract

Two Bit Circus collaborated with the Girl Scouts of the Greater Los Angeles Area to explore the exciting world of wearable electronics. Over the course of the program, the students explored concepts of introductory electronics while designing and creating their own illuminated fashion piece. The program was held in Montrose, CA in Fall 2013. The students were approximately 10 girls ages seven to 14. The program was held over seven sessions with each session lasting 80 minutes.

Keywords

Girl Scouts, Basic circuitry, Parallel circuits, Positive/negative, Conductive vs. nonconductive materials, Electrical shorts and troubleshooting

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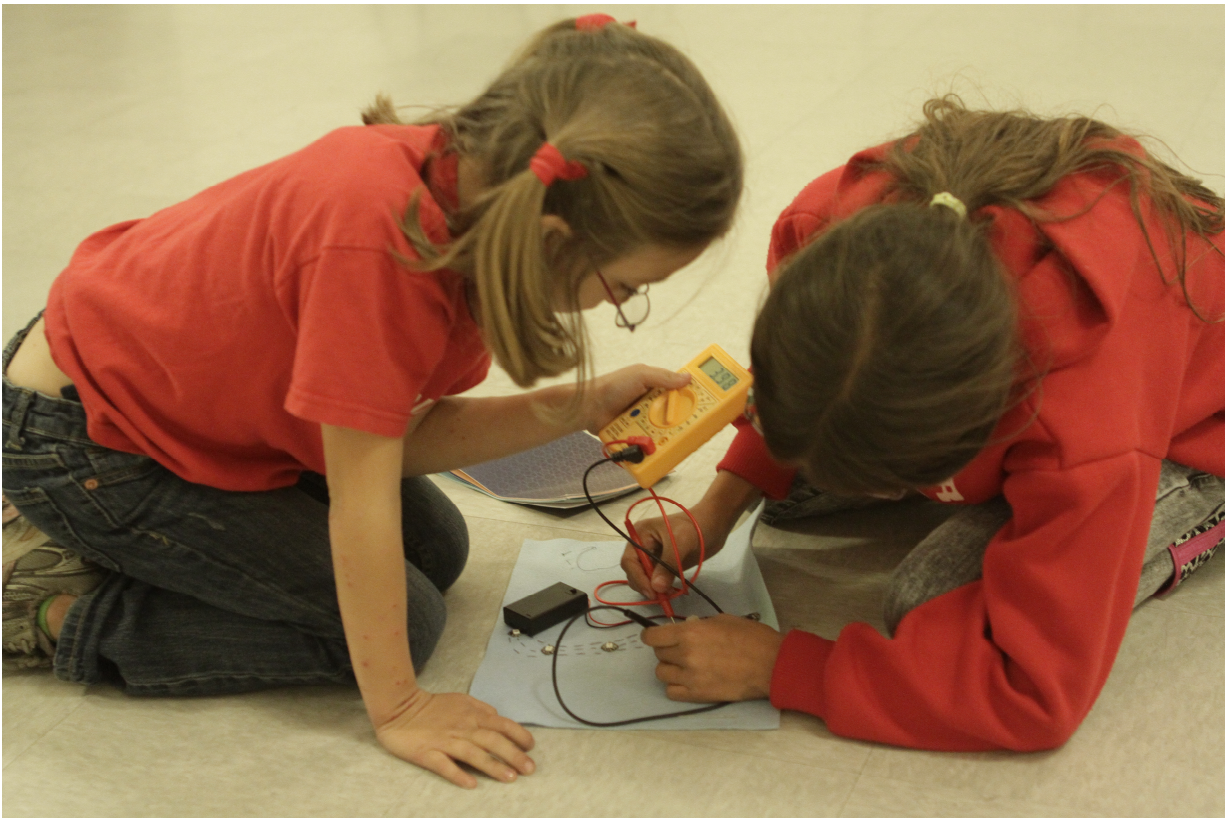
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Two Bit Circus

Elise Lemle

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Learning Objectives

1. Introduce students to concepts, terminology, and design of electronics
2. Encourage students to move from consumers to creators by designing and fabricating their own wearable electronic projects.
3. Facilitate exploration and discovery in the following curricular areas:
 - Basic circuitry
 - Parallel circuits
 - Positive/negative
 - Conductive vs. nonconductive materials
 - Electrical shorts and troubleshooting
4. Develop making and tinkering skills through experimentation and productive failure.
5. Facilitate development of shared knowledge base and learning community.
6. Encourage personal expression through student-designed project.
7. Create a wearable electronic project to be modeled during the GirlTopia Wearable Electronic Fashion Show.

Method

The program was led by an instructor from Two Bit Circus. The accompanying curriculum used scaffolded, visually-driven instructions to guide the students through creating a wearable electronic project using LEDs and the LilyTiny, a microcontroller pre-programmed with multiple LED output functions.

The program concluded with a wearable electronic fashion show at the Girls Scouts' GirlTopia, an event with over 9,000 attendees held at the Los Angeles Convention Center.

Session One – Introduction and Inspiration

Students spent some time getting to know one another and establishing group norms for their time together. The instructor used a PowerPoint presentation to introduce the program and explain the project trajectory.

The students created small drawstring bags to hold their projects-in process. This short project allowed the students to review several sewing and construction techniques in advance of working with conductive thread.

Session Two - Exploring and Design

The session began with the group gathered together. The instructor led a discussion exploring what the group already knew about electricity and what they hoped to learn.

Pairs of students were given the Exploration Packs (contents outlined below) and tasked with illuminating one of the LEDs. Little instruction was intentionally given in order to facilitate active discovery. After students successfully created a basic circuit, illuminating a LED, they were challenged to figure out one (or several) ways of connecting a second LED. Students who had prior knowledge of circuit function were encouraged to mentor inexperienced students.

After the students experimented with the Exploration Pack, the group gathered to discuss their findings and discoveries. The instructor used large graph paper to draw diagrams illustrating circuitry concepts, including polarity, conductivity, and short circuits. To further explore the circuitry concepts, the instructor led the group in a musical-chairs type circuit simulation game.

The instructor distributed the STEAM Carnival Light Up Fashion Kit to each student. As a group, the students discussed the similarities and differences between the electrical components they used in the Exploration Packs and the Light Up Fashion Kit. The instructor introduced the LilyTiny microcontroller and how it might be used in student projects. The instructor demonstrated the capabilities of the LilyTiny with a pre-sewn circuit. The students used the components from their kits and alligator clips to

create prototype circuits. The rapid prototyping approach allowed for the students to immediately see results (i.e. an illuminated LED) at each step prior to embedding the circuit into their sewn project.

Utilizing their developing knowledge, the students began sketching ideas for their individual projects on large pieces of graph paper. The students were encouraged to think big and create several ideas. Emphasis was placed on upcycling - using technology to re-imagine an unwanted or old piece as something new and fabulous.

Session Three - Design and Layout

At the beginning of the session, the instructor distributed the STEAM Carnival Light Up Fashion Curriculum. The instructor briefly introduced the curriculum and discussed how the students might best utilize the resource. The group then reviewed the LilyTiny microcontroller function and how it might be applied in their individual projects. The students continued sketching their project ideas. As they began to refine their ideas, students were encouraged to begin thinking about how they might layout their components for effective circuitry design.

Session Four through Seven - Sewing and Troubleshooting

During these three sessions, students worked on sewing their individual projects. Students finalized their layouts on their chosen base fabric or clothing article. They used adhesive dots to keep the components in place while sewing. Prior to sewing, students marked dashed lines to chart where their circuit would travel.

Students then used conductive thread to connect the electrical components. During Session Six, the instructor introduced a multi-meter and explained how students could use the tool to troubleshoot their projects if they were not lighting up as intended. After completing their circuit, the students added final decorative elements.

Final Event - GirlTopia Wearable Electronic Fashion Show

The program concluded with the students celebrating their achievements through participating in a fashion show. The wide range of projects created included an illuminated purse designed to hold pencils and pens, a shawl re-imagined as a lighted skirt, and light-up athletic socks designed to keep a runner safe at night.

Three industry leaders lead a panel that provided substantive feedback to each of the students during the show. The event concluded with a Q&A from the audience during which the students discussed their learning process and future plans in STEAM.

Resources

STEAM Carnival Light Up Fashion Kit

- LilyTiny microcontroller
- LilyPad battery holder
- LilyPad LEDs
- Conductive thread
- 3V 2031 batteries

Shared tools and materials

- Needles
- Needle threaders
- Scrap fabric and trim
- Decorative notions
- Yarn and ribbon
- Hot glue guns
- Scissors
- Adhesive dots
- Multimeter
- Markers
- Large graph paper

10 Exploration Packs (used in pairs). Each Pack contains:

- Two 10mm red LEDs
- Two red alligator clip leads
- Two black alligator clip leads
- Battery holder with lead wires
- 3V 2031 battery

Designing and executing this curriculum was a blast. STEAM provides natural inspiration to engage our next generation of problem solvers and thought leaders. Specifically for this project, crucial to the curriculum development process was finding the appropriate point of access for the female students, ages seven to 14. The research process involved spending time with Girl Scouts learning about their interests and curiosities, along with consulting countless teen fashion magazines and scouring the Internet for inspiring projects. Paramount was finding the right balance of fashion, functionality, and accessible technology that would engage their tween and teen sensibilities.

My iterative design prototyping process mirrored the organizational structure outlined in the curriculum. Tinkering with the materials was an essential part of process- giving myself space to experiment and play allowed for new ideas to surface and be tested, as well as anticipate where the students might have difficulty. At times, this process was riddled with “productive failure” a concept I encouraged the students to also embrace. During the creation of the accompanying curriculum guide, the primary challenge was breaking down complex or abstract concepts into digestible ideas and engaging activities. Collaborating with my colleagues at Two Bit Circus was invaluable, allowing for real-time product and curriculum testing. Finally, the enthusiastic wearable electronics community provided tremendous support and inspiration.