Wear Your LEDs: Getting Started e-Textiles Program Proposal

Description
Patrons get an introduction to circuits, working with LEDs, and e-textiles by making a fabric wrist cuff that lights up. Practice building circuits, working with conductive thread and Lilypad electronics parts. This two-part program works well in a series about circuitry, and the project is appropriate for gift-giving holiday programs, or a safety theme.

Audience
Teen/Adult

Budget/Costs
Durable Goods Investment: $14.95
Consumables: $148
Cost/participant: $6.19

Number of participants
24 in 3 classes of 8

Program Time
3 hours plus ½ hour staff setup time

Collection and Dewey Connections
Design - 745.4
Electric Circuits - 621.31
Electronics - 621.381
Handicrafts - 745.5

STEAM Tie-ins
Science: electricity, magnetism, light
Technology: circuits, LED lights
Engineering: Electrical engineering
Art: colors, shape, composition
Math: Reading measuring devices

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Wear Your Light: Getting Started With LED e-Textiles

Method [TOTAL TIME: 4 hours (Prep - Cleanup)]

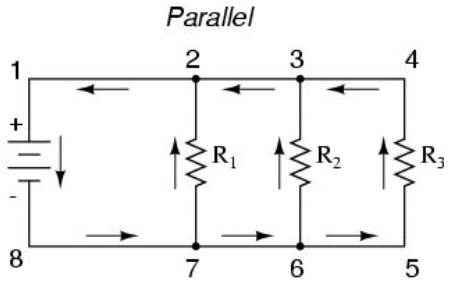
Prepare area: 15 minutes

1. Print patron handouts.
2. Arrange equipment and supplies on tables
3. Optional: Test multimeter

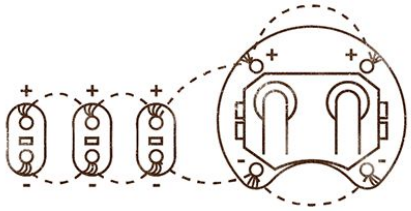
Day 1: Introduction: 10 minutes

- Introduce yourself
- Provide overview
    - Day 1
        - Optional: Before the wristband, make a super simple circuit (throwie)
        - Draw a draft of the wristband and circuit on paper
        - Cut the fabric/felt and transfer the draft to the fabric
        - Sew the circuit with conductive thread from the battery holder to the LEDs
        - Test and troubleshoot
    - Day 2
        - Finish sewing the circuit if needed
        - Test and troubleshoot
        - Sew on embellishments and sew (or hot glue) a back lining on if needed.
        - Sew on the velcro closures.
- Explain timeline and safety precautions for activity (hot glue if using it)

Design the layout and circuit: 15 minutes



1. Discuss supplies and how they will make a parallel circuit.
    a. Switched battery holder: +/-. This has to be oriented correctly to match stitching
    b. LEDs: +/-. Charges must be aligned.
    c. Thread: conducts current from the battery through LEDs and back.
    Stitching cannot cross over or touch itself or it will short the circuit.
    The battery holder will be on the front of the fabric.
    **The LEDs may be on the front of the band so that they shine directly OR on the back of the fabric with the LED facing the fabric so that they shine THROUGH the fabric.
2. Sketch the circuit and design on paper. Locate
    a. Battery holder and its polarity
    b. LEDs and their polarity
    c. Stitching - can be decorative or hidden
    d. Velcro closure



Here are some typical runtimes for various SparkFun batteries and numbers of LilyPad LEDs/LilyPixels:

	Number of LEDs	1	2	5	10	20
Battery Name	**Battery mAh**	**Hours of Operation**				
Polymer Lithium Ion Battery - 40mAh	40	1.3	0.8	0.4	0.2	0.1
E-Textiles Battery - 110mAh (2C Discharge)	110	3.7	2.2	1.0	0.5	0.3
Coin Cell Battery - 20mm (CR2032) *	250	8.3	5.0	2.3	1.2	.61
Polymer Lithium Ion Battery - 400mAh	400	13.3	8.0	3.6	1.9	1.0
Polymer Lithium Ion Battery - 850mAh	850	28.3	17.0	7.7	4.0	2.1
Polymer Lithium Ion Battery - 1000mAh	1000	33.3	20.0	9.1	4.8	2.4
Polymer Lithium Ion Battery - 2000mAh	2000	66.7	40.0	18.2	9.5	4.9
Polymer Lithium Ion Battery - 6Ah	6000	200.0	120.0	54.5	28.6	14.6

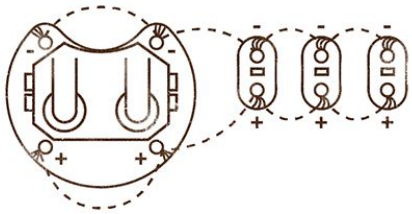
* Note: the Coin Cell Battery is non-rechargeable.

Cut and prepare the fabric/felt: 10 minutes

1. Cut 2 pieces of felt 2-3” wide and long enough to fit around wrist with a 3” overlap that will cover the battery holder and velcro.
2. Cut any additional pieces and embellishments that you will attach.
3. Transfer the circuit layout to the fabric
4. (optional) Use regular or hot glue (the least amount possible) to attach the LEDs and battery holder. Don’t get any glue on the tabs
   Watch +/- orientation so + are lined up and on the same side as battery holder +!

Stitch the circuit with conductive thread: 45 minutes

1. Cut a length of thread no more than twice the length of your band to prevent it from twisting and knotting. Cut the thread so that it’s easier to thread the needle.
2. Thread a needle with a large eye.
3. Knot one of the ends of the thread so that you can untwist it easily if needed.
4. Put three stitches into the battery holder’s first positive terminal. Sew 3 or 4 short running stitches toward the second terminal, and then put 3 or 4 stitches into the second terminal.
   *If your LEDs will be sewn on the back of the fabric, use the needle to draw the thread to the back of the fabric.



5. Use short running stitches (¼”) to sew from the battery to the first LED. Stitches can go all the way through the fabric on either side. If they go through on the front, they will be decorative. If you make them hidden, be sure they will not cross into the area where you will sew the negative circuit path.
6. Stitch into the + LED terminal three times to secure it..
7. Continue sewing from + LED to + LED until all of the LEDs are connected.
   a. Finish the line of stitching in a decorative way if your stitches show.
   b. End last stitch to back of band. Knot. Trim the thread close to the knot so that it can’t come in contact with the negative line.
8. Repeat steps 3 - 7 to stitch from the - battery terminals to the - LED terminals.

9. Trim any thread ends near the battery holder and check your stitching for loose stitches or connections between + and -.
10. Put a battery in the holder, turn on your switch, test, and troubleshoot! https://learn.sparkfun.com/tutorials/lilypad-basics-e-sewing

    **If you need to continue sewing, remove the battery to prevent short circuits.

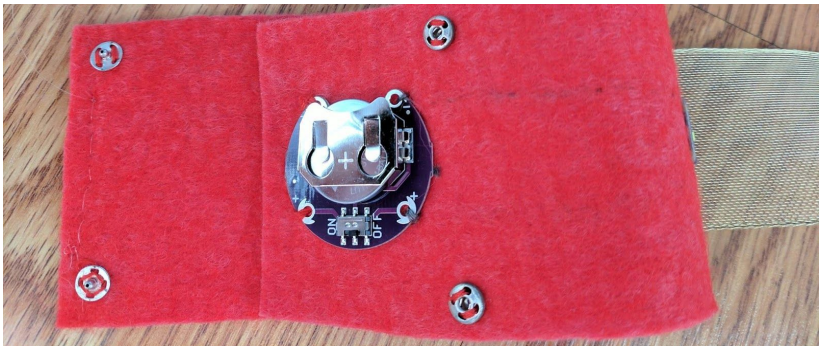
Clean up and store materials: 10 minutes

Day 2

Distribute projects and materials: 5 minutes

Finish sewing the circuit if needed, stitching and add any embellishments: 75 minutes

1. Stitch on trim and any embellishment with regular thread.
2. (Optional) Brush a dab of nail polish on each of the conductive thread stitches that attach to the battery holder and LEDs to keep them from fraying.
3. Glue the second piece of fabric to the back of the band, along the outside edge
   This will keep your skin from acting as a conductor and short circuiting your band.
4. With regular thread, stitch on velcro using short running stitches.
    a. Attach hook side INSIDE/TO THE LONG SIDE of the battery holder on the band
    b. Flip the band over. Attach the fuzzy side at the end opposite the battery holder



Clean up, take photos, and complete patron survey: 10 minutes

Optional: A super simple circuit - Make throwies/tossies: 10 minutes

1. LED, battery, magnet, tape
2. Note LED leg length (+ is longer), battery +/- sides. **Demonstrate multimeter use.
3. Slide the battery between the legs of the LED. Does it work?
    a. If not, flip over the battery.
    b. To create the circuit, + must be with + and - with -.
4. Attach the magnet on negative side
5. Tape
6. Throw

Discuss, take photos, clean up, complete program survey: 10 minutes

[Total BooX Circuits and Electronics Shelf]

Related links

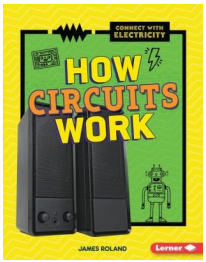
- http://www.instructables.com/id/LED-Owl-Pin/
- http://www.instructables.com/id/Sewing-Simple-Circuits/
- http://www.instructables.com/id/Soft-circuit-LED-Bracelet/
- https://www.allaboutcircuits.com/textbook/direct-current/chpt-5/what-are-series-and-parallel-circuits/
- https://www.youtube.com/watch?v=IJI0OV0y49U
- https://www.youtube.com/watch?v=XT5ygUt8Cbk
- https://learn.sparkfun.com/tutorials/twinkle-zodiac-constellation
- https://learn.sparkfun.com/tutorials/powering-lilypad-led-projects

Wear Your Light: Getting Started With LED e-Textiles Budget

Equipment	Price	Quantity	Total	Link
Digital Multimeter - Basic	$14.95	1	$14.95	https://www.sparkfun.com/products/12966
Subtotal			$14.95	
Consumable Supplies				
Felt for wristbands	$16.00	1	$16.00	https://www.amazon.com/Life-Glow-Polyester-Squares-Assorted/dp/B019RIWEEK/ref=sr_1_5?ie=UTF8&qid=1499268027&sr=8-5&keywords=felt
Conductive Thread Bobbin - 30ft (Stainless Steel)	$2.95	4	$11.80	https://www.sparkfun.com/products/10867
LilyPad LED Yellow (5pcs)	$2.95	3	$8.85	https://www.sparkfun.com/products/14014
LilyPad LED Green (5pcs)	$2.95	3	$8.85	https://www.sparkfun.com/products/14011
LilyPad LED Blue (5pcs)	$2.95	3	$8.85	https://www.sparkfun.com/products/14012
LilyPad LED Red (5pcs)	$2.95	3	$8.85	https://www.sparkfun.com/products/14013
LilyPad LED White (5pcs)	$2.95	3	$8.85	https://www.sparkfun.com/products/13902
LilyPad Coin Cell Battery Holder - Switched - 20mm	$1.95	24	$46.80	https://www.sparkfun.com/products/13883
Needle Set	$1.95	4	$7.80	https://www.sparkfun.com/products/10405

Tong 30 Colour Spools Sewing Thread 250 Yards Each	$9.99	1	$9.99	https://www.amazon.com/Colour-Spools-Polyester-Purpose-Machine/dp/B06XHKN116/ref=sr_1_23?s=arts-crafts&ie=UTF8&qid=1501627478&sr=1-23&keywords=thread
Vkey 500pcs (250 Pair Sets) 3/4" Hook & Loop Self Adhesive Dots	$8.99	1	$8.99	https://www.amazon.com/Vkey-500pcs-Diameter-Sticky-Adhesive/dp/B012EWJIXG/ref=sr_1_fkmr0_4?s=arts-crafts&ie=UTF8&qid=1501627942&sr=1-4-fkmr0&keywords=velcro+dots+sew+on
GI CR2032 3V Lithium Coin Battery, Bulk in Trays (package of 200 @$24.00)	$0.12	24	$2.88	http://www.cheap-batteries.com/p/GI-CR2032.html
Subtotal			$148.51	
Total			**$163.46**	
Cost per participant 24 participants (3 classes of 8)			$6.19	
Standard Lab supplies				
Standard copy paper for sketching (can be scrap), scissors, pencils, Scotch tape, white glue				
Optional				
Conductive Fabric Hinges	$9.00	1		https://chibitronics.com/shop/conductive-fabric-tape-patches/
LilyPad e-textile starter kit (supplies for 10 participants)	$199.99	1	$199.99	https://www.sparkfun.com/products/13165
Sure Electronics Super Bright 3mm T-1 LED 105 Piece Assortment 7 Different Colors (9.60+6.85 shipping)	$16.45	1	$16.45	http://www.parts-express.com/sure-electronics-super-bright-3mm-t-1-led-105-piece-assortment-7-different-colors-with-volt--073-007
Stanley Tools GR20AX Trigger Feed Hot-Melt Glue Gun	$9.30	5	$46.50	https://www.amazon.com/Stanley-Tools-GR20AX-Trigger-Hot-Melt/dp/B00WR06U7S?ie=UTF8&keywords=Stanley%20Tools%20GR20AX%20Trigger%20Feed%20Hot-Melt%20Glue%20Gun&qid=1444868229&ref_=sr_1_1&sr=8-1&tag=top080-20
Clover Water Soluble Pencil Assortment, 3EA	$7.06	1	$7.06	https://www.amazon.com/Clover-Water-Soluble-Pencil-Assortment/dp/B000B836P2/ref=sr_1_1?ie=UTF8&qid=1501704602&sr=8-1&keywords=sewing+chalk+pencil
LilyTiny	$4.70	24	$112.80	https://www.sparkfun.com/products/10899
LilyPad Rainbow LED (6 Colors) - can be used instead of individual colors	$3.50	12	$42.00	https://www.sparkfun.com/products/13903

Related Titles



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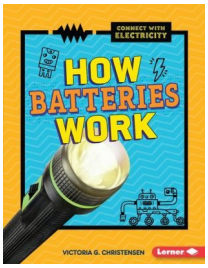

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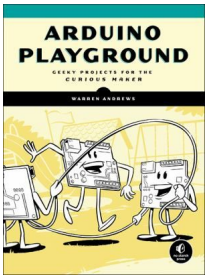

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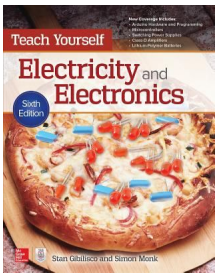

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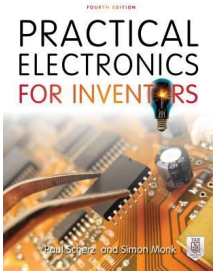

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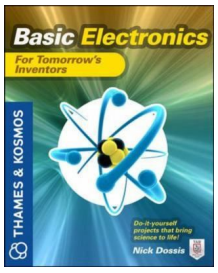

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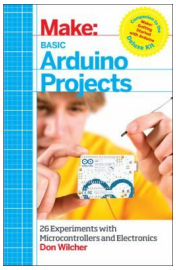

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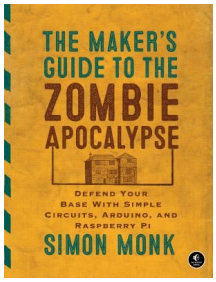

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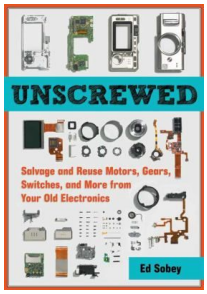

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Help Sheet: Terminology & Support

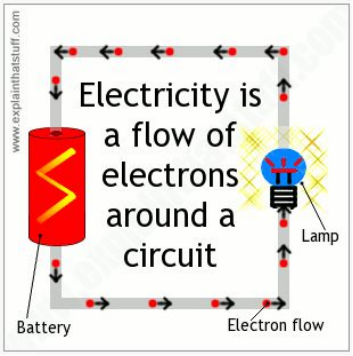
Cleaning Your Project

If your project gets dirty, remove the battery and carefully hand wash with mild detergent. Let your project air dry; a dryer can damage the LilyPad pieces or stitching.

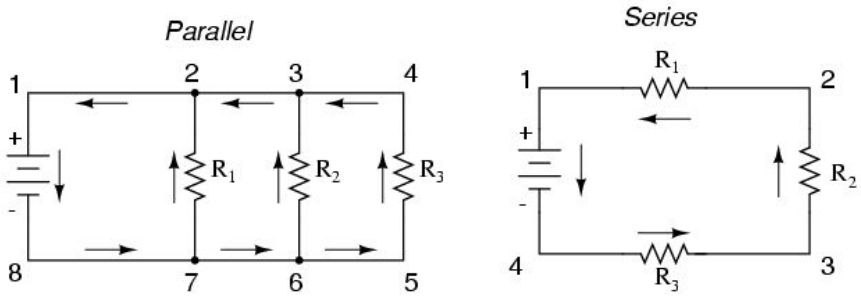
LED (Light Emitting Diode)

- red, orange and yellow LEDs contain aluminum gallium indium phosphide (AlGaInP) alloys
- green, blue and white LEDs contain indium gallium nitride (InGaN) alloys

Circuit



- a closed path or loop through which electricity flows
- The electric power in a circuit is equal to the voltage × the current (volts × amps = watts).



Current

- Steady flow of electrons
- Measured in amperes (amps)

Voltage

- An electromagnetic force (EMF) that pushes electrons along a current
- The bigger the voltage, the more current will tend to flow

Conductor

- A material that allows electricity to flow freely (many “free” electrons, not tightly bound together)
- High conductance; low resistance

Insulator

- A material that doesn’t allow electricity to flow freely (few “free” electrons, tightly bound together)
- Low conductance; high resistance

Credits: http://www.explainthatstuff.com/electricity.html

Digital Learning Survey

Your response to this brief survey helps to improve programming in the short and long term. Thanks in advance for your input!

You feel more knowledgeable about using digital resources

- Agree
- Disagree

You feel more confident when using digital resources

- Agree
- Disagree

You intend to apply what you just learned

- Agree
- Disagree

You are more aware of applicable resources and services provided by the library

- Agree
- Disagree

What did you like most about the program?

What could the library do to improve your learning?

What other projects would you like to learn?

Where did you hear about the program?

Program Survey

Your response to this brief survey helps to improve programming in the short and long term. Thanks in advance for your input!

On a scale of 1 to 5, rate your knowledge of and confidence about the activity BEFORE the program.
1 - I've never heard of it.
2 - I've heard of it but don't have much knowledge of it. I haven't participated in it.
3 - I have participated in this activity once. I am a novice.
4 - I have some knowledge about the activity and have participated in it as a hobby or past time.
5 - I am an expert or professional in this field or activity.

On a scale of 1 to 5, rate your knowledge of and confidence about the activity AFTER the program.
1 - I've never heard of it.
2 - I've heard of it but don't have much knowledge of it. I haven't participated in it.
3 - I have participated in this activity once or twice. I am a novice.
4 - I have some knowledge about the activity and have participated in it as a hobby or past time.
5 - I am an expert or professional in this field or activity.

What did you like most about the activity?

How likely is it that you will recommend this program to someone?
Very likely
Not likely

If you answered "Not likely" above, why not?
It needs to be better organized.
It wasn't fun.
I didn't like the materials.
I wasn't happy with my finished product.
Other:

Where did you hear about the program?

What suggestions do you have for making the activity better?

What suggestions do you have for other programs at the library?