Soft Circuits

Combining conductive threads and fabrics with electronic components such as lights, batteries, switches and sensors to create an electrical circuit brings technology and electronics into the textiles classroom. Students can begin with a simple circuit then move onto more complex design elements.

Examples: Simple circuits in soft toys



Background reading

Soft Circuitry bog post: http://stem.global2.vic.edu.au/2016/06/28/soft-circuitry/

Making DigiPub: http://www.digipubs.vic.edu.au/pubs/maker/home

Invent to Learn workshop kit: http://www.inventtolearn.com/wp-content/uploads/2013/08/online-ITL-workshop-kit.pdf

STEAM project lets Middle School girls design wearable technology: http://inspirationlab.org/story/7418

Horizon Report – Wearable Technology, Pg: 46-47: http://cdn.nmc.org/media/2016-nmc-cosn-horizon-report-k12-EN.pdf

SparkFun – Soft Circuit video

https://youtu.be/OP0LCBz40Do

Victorian Curriculum F-10 Learning Area: Design and Technologies, Level 7-8

Achievement Standards

- Students explain how the features of technologies impact on designed solutions and influence design decision
- Students create designed solutions based on an evaluation of needs or opportunities and develop criteria for success.
- Students create and adapt design ideas, make considered decisions and communicate to different audiences using appropriate technical terms and a range of technologies
- Students apply project management skills to document and use project plans to manage production processes.
- They independently and safely produce effective designed solutions for the intended purpose.

Content Descriptions:

- Investigate the ways in which designed solutions evolve locally, nationally, regionally and globally through the creativity, innovation and enterprise of individuals and groups (VCDSTS044)
- Analyse ways to create designed solutions through selecting and combining characteristics and properties of materials, systems, components, tools and equipment (VCDSTC048)
- Critique needs or opportunities for designing and investigate, analyse and select from a range of materials, components, tools, equipment and processes to develop design ideas (VCDSCD049)
- Generate, develop and test design ideas, plans and processes using appropriate technical terms and technologies including graphical representation techniques (VCDSCD050)
- Effectively and safely use a broad range of materials, components, tools, equipment and techniques to produce designed solutions (VCDSCD051)
- Independently develop criteria for success to evaluate design ideas, processes and solutions and their sustainability (VCDSCD052)
- Use project management processes to coordinate production of designed solutions (VCDSCD053

Assessment:

Students will use a design brief to create a soft toy that incorporates a soft circuit. They should document the process for creating their designed solution using digital tools (such as a blog, photo story, video, PowerPoint).

Adapt to Level 5-6:

- Students produce a toy using a class template that incorporates soft circuits, they negotiate criteria for success.

Adapt to Level 9-10:

- Students produce an item of clothing or product incorporating soft circuits, they develop their own design brief and justify success criteria.

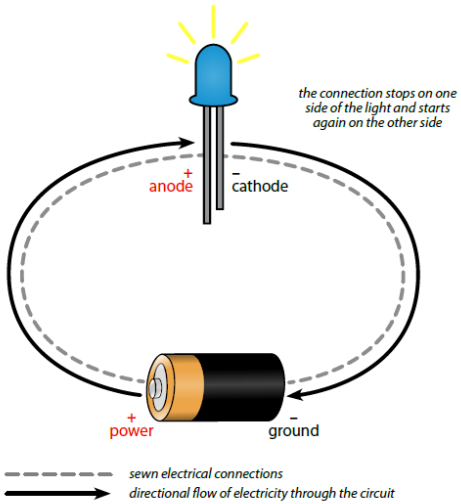
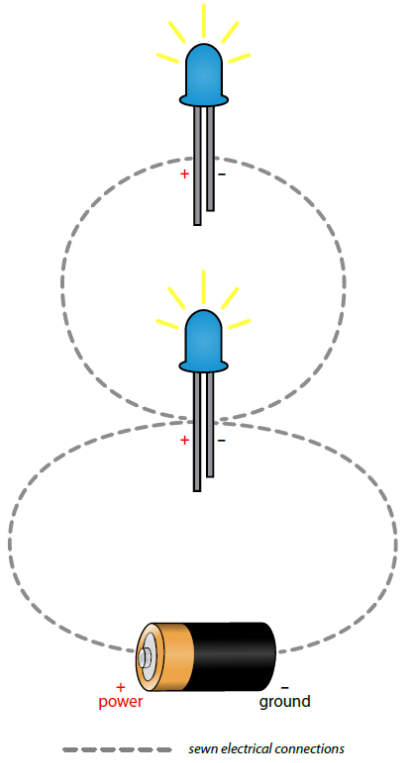
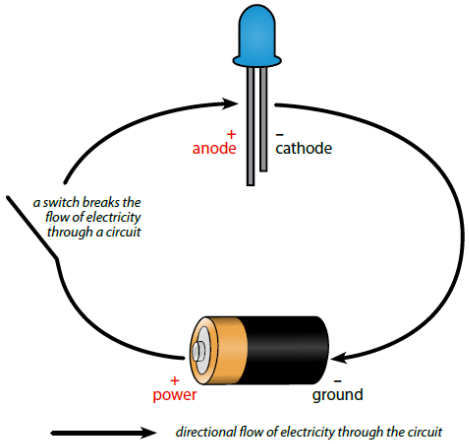
Lesson sequence:

Lesson Focus	Learning Activities / Assessment	Resources and Examples

Investigating
 	
Students will be able to explain how soft circuits and technology are being used in textiles.
	Students conduct an online investigation of the ways that soft circuits and technology are being used in textiles and present an annotated visual report.
	
	Students develop a visual report / mood board of which includes:
	• Images and/or videos of a range of wearable technologies
	• Annotations on at least three design ideas that explain
	  ○ the implications of the technology for individuals or society
	  ○ the influence of the technology on product design
	  ○ identification and justification of the tools, processes and equipment used.
	
	Consider using: A Pinterest board (must be over 13), PhotoStory, PowerPoint, Blog or Comic Life.
		• eTextiles on Pinterest
		• FUSE Package ID: B2TQQX eTextiles and Wearable Technologies
		• 9 Futuristic Clothing Technologies available now: https://youtu.be/pB_IbQk0rGY
		• Twinkling Stars Skirt from ThinkGeek: https://youtu.be/0KoLC-ThZx4
		• Cute Circuit Wearable Technology: https://cutecircuit.com/

Generating Students develop and test ideas for their soft toy.	Design Ideas and Story Board • Students design their own soft toy (or adapt a class template) with sketches/visualisations leading to their design. Test design ideas: • Cutting and hand sewing felt samples with regular thread • Sewing a simple circuit that connects a light and battery Production plan • Production sketch including the circuit pattern outlining how the soft circuit will work and where the battery will sit • Identify and justify he materials and tools needed • Identify and justify finishing touches and embellishments • Identify criteria for success	Activity 1 in Lovell, E, Getting hands-on with soft circuits pg 4 Students who are comfortable with the basic soft circuits may choose a parallel circuit with two or more LED or incorporating a switch (see extension ideas)

Producing Students will effectively and safely produce their toy.	Follow production plan and include ongoing evaluation for each stage (including any modifications made along the way).	Lovell, E, Getting hands-on with soft circuits http://stem.global2.vic.edu.au/2016/06/28/soft-circuitry/
Evaluating Evaluate production plan and their final product	Students evaluate their design idea against their criteria for success.	
Differentiation / Extension	Students can create a wearable technology that addresses a need or opportunity – go to UNICEF's Wearables for Good for resources and examples http://wearablesforgood.com/ **Extension** Students who are comfortable with a simple circuit with one LED, can create a parallel circuit with two or more LED's, a switch with a press-stud or a soft switch that is operated by pressing conductive fabrics together. • On/off switch, using conductive fabric: https://youtu.be/OP0LCBz40Do • Fabric Origami: https://youtu.be/mut4zTQuz88 • Textiles Switch: http://crunchwear.com/learn-how-to-make-a-textile-switch/ • Parallel Circuits Lovell, E, Getting hands-on with soft circuits • LilyPad Arduino are great for more complex interactive projects with sensors, motors, speakers, flashing lights and other programmable features. Students can design an item of clothing that uses soft circuits – consider, how are they connected, what fabric is used, how to the soft circuits contribute to the design.	**Online tutorials and templates can be found at:** SparkFun Electronics: https://learn.sparkfun.com Sew Electric: http://sewelectric.org/diy-projects/ Instructables: http://www.instructables.com/ and http://www.instructables.com/class/Wearable-Electronics-Class/

Simple Circuit	Parallel Circuit	Basic Switch
Identifying Polarity  ***A Simple Circuit Schematic*** 	***Simple Circuit Schematic for Lights in Parallel*** 	***Simple Circuit Schematic for a Switch***  Use metal snaps to act as the on off switch  Lovell, E, Getting hands-on with soft circuits

Sewing & Electronics Projects

- Wearables
- Stuffies
- Power Gloves
- Belts
- Headbands
- Finger Puppets
- Storyboards
- Ornaments

Components

Material: Felt, foam, fabric
Electrical connectors: Conductive thread, pipe cleaners, wire
LEDs - Light Emitting Diodes
Power: Coin cell batteries & sewable battery holders
Sewing supplies: Needles, thread, scissors, pliers, snaps, safety pins, velcro

Sewable Battery Holder

Coin Cell Battery

LED

Conductive Thread

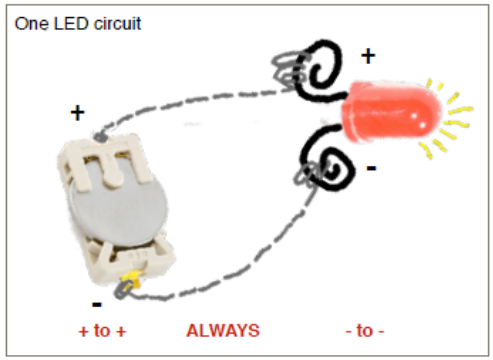
LED SEWING TIPS

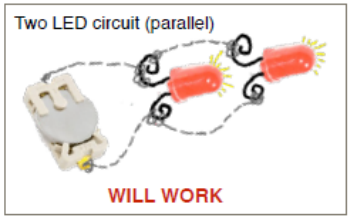
small (3mm) - medium (5mm) - large (10mm)

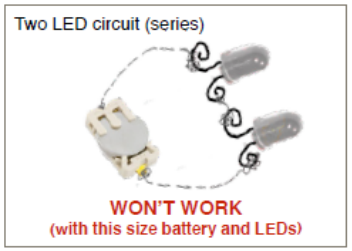
- You cannot shock yourself or burn out LEDs if you stick to coin cell batteries
- Prototype your circuit. Smaller LEDs use less power, bigger and flashers use more.
- Use the same color and size in one project
- Use a Sharpie to mark the positive (+) leads of LEDs and battery holder
- When the LED is in place, spiral the leads with pliers. This will hold it in place and give additional area to tightly connect the conducive thread to the lead.

component images from sparkfun.com

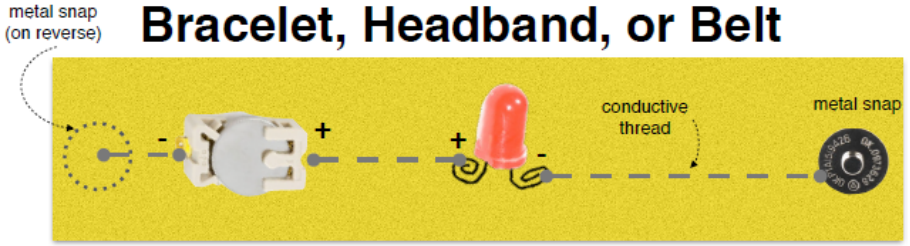
Simple LED Circuits







Try It! - Wearable Bracelet, Headband, or Belt



1. Cut a piece of felt that will wrap loosely around your wrist plus extra.
2. Sew a battery holder and LED onto felt with conductive thread. Connect the positive leads with conductive thread.
3. Use a metal snap at the ends of the bracelet as a switch. Make sure one snap is on the reverse side. Test to make sure it snaps correctly.
4. Connect negative leads to snaps with conductive thread.
5. Secure any loose parts with regular thread.
6. Test and decorate!

SEWING TIPS

- Use conductive thread only where necessary. Connect it tightly to components.
- Use regular thread for construction.
- Make sure conductive thread doesn't gap or "short" the circuit. The negative sides should never touch the positive sides.
- Spread the LED leads so they don't touch.
- Save your battery - a switch is anything that breaks (and reconnects) your circuit. Here the snap is a switch.

component images from sparkfun.com