# Light up Soft Toy with LilyPad

**Year level band:** 7-8

**Description:**

This project will explore two ways of controlling the flow of current to a LED using a button and switch. No programming is initially expected in this project, however once students are comfortable with connecting or sewing their circuits and attaching lights, a follow-up project that involves using a pre built Arduino program to light up a series of lights in order would be a useful next step.

**Lesson Type:** Introductory

**Resources:**

- Lilypad ProtoSnap kit with rechargeable battery
- LilyPad LED's
- Conductive thread
- Alligator clips
- Arduino IDE installed onto computers
- Mini USB cable
- Chalk or pen for marking fabric
- Felt/Material
- Scissors
- Paper
- Needle
- Pencils for design sketches
- Embroidery hoop (suggested)

The LilyPad is an Arduino device designed for e-textile design activities using conductive thread and sewn into fabric.The LilyPad system was designed by Leah Buechley at the University of Colorado Boulder. The commercial version of the kit, which launched in 2007, was collaboratively designed by Leah and SparkFun Electronics. You can learn more about LilyPad at SparkFun.com/LilyPad.

**Prior Student Learning:**
The understanding of simple circuits both serial and parallel is an advantage prior to commencing work with the LilyPads.

Parallel circuit simulation This resource also addresses Science Understanding in the area of physical science for up to year 9 science students. Students learn some Science Inquiry Skills in the process of the simulation. This resource should be used with other Intel resources on electric circuits for maximum benefit. A resource can be found on the Digital Technologies Hub

Series circuit simulation In this simulation students select and move a battery, switch and two light bulbs to positions around a circuit so that the light bulbs are in series with each other. Students

receive feedback if their circuit is not a working series circuit. Students drag and drop a battery, switch, and two light bulbs into position on a circuit. Students can compare the brightness of one bulb in a circuit and two bulbs in series in the circuit. A resource can be found on the Digital Technologies Hub

In this exercise no programming is required;

Some practical sewing skills using a needle and thread would be desirable.

**Digital Technologies Summary Achievement Standards.**

By the end of Year 8, students will have had opportunities to create a range of digital solutions, such as interactive web applications or programmable multimedia assets or simulations of relationships between objects in the real world.

Students plan and manage digital projects to create interactive information. They define and decompose problems in terms of functional requirements and constraints. Students design user experiences and algorithms incorporating branching and iterations, and test, modify and implement digital solutions. They evaluate information systems and their solutions in terms of meeting needs, innovation and sustainability. They analyse and evaluate data from a range of sources to model and create solutions. They use appropriate protocols when communicating and collaborating online.

| Band | Content Descriptors |
|---|---|
| **Seven and eight** | Design the user experience of a digital system, generating, evaluating and communicating alternative designs (ACTDIP028)<br><br>● presenting and comparing alternative designs to a solution for a problem, for example presenting alternative design mock-ups to the class<br><br>Evaluate how student solutions and existing information systems meet needs, are innovative, and take account of future risks and sustainability (ACTDIP031)<br><br>● comparing student solutions with existing solutions, such as interactive, educative toys |
| | Reflect on thinking and processes<br>● evaluate and justify the behind choosing a particular problem-solving strategy<br>Apply logic and reasoning<br>● identify gaps in reasoning and missing elements in information |

| Element | Summary of tasks |
|---|---|
| Learning hook | Create a plush toy that lights up with LED lights and program. Students will have the opportunity to work with needle and thread to sew a circuit where LED lights turn on and off on elements of a plush toy (e.g., eyes). This is an introductory activity that will later lead to a programming task using the Arduino IDE Software.<br><br>This is an opportunity to engage students in a creative task using a range of materials that can then be made interactive and engaging which will allow students to then explore more complex e-textile activities using the various sensors on a LilyPad.<br><br>The LilyPad Arduino is a great introduction to wearable technology or e-textiles. You can create amazing projects and sew them into your clothes, toys, backpacks to make them light up, play music and vibrate.<br><br>Perhaps show some examples of wearable technology and e-textiles. There are plenty of examples on Pinterest, e.g. https://www.pinterest.co.uk/vinidiktova_len/lilypad-arduino/?lp=true or<br><br>https://www.pinterest.com.au/kitelder/e-textiles-lilypad-arduino/?lp=true<br><br>Some examples of LilyPad projects can be found here - maybe show a couple of interesting ones: https://https://www.instructables.com/howto/lilypad/<br><br>Describe each component of the LilyPad kit, and allow the students to explore the kit, asking them what they think each component might be. Explain the functionality of the main round board, and that inputs can be digital or analogue. Digital has two states (on/off, high/low, or true/false) but analogue can take values in between. Identify the components of the kit that are analogue or digital.<br><br>When discussing each component, discuss how it can be used in programming. Is it an input component (that is, it provides input to the board)? If so, then values need to be read from it, like from a light sensor. Is it an output component? If so, then values need to be written to it, like to a LED.<br><br>When discussing how code can be written for the LilyPad Arduino to interact with these components, introduce the concept of functions and discuss how arduino has pre-defined functions for all the LilyPad components. Some of these functions include:<br>● loop - for repetition<br>● delay - delays action<br>● pinMode - for configuring the specified pin to behave either as an input or an output<br>● digitalWrite - for writing a low or high value to a pin<br><br>A full documentation and description of these functions is available at:<br><br>https://www.arduino.cc/en/Reference/ |

<table>
<tr><td>Achievement Standards<br><br>Learning Map (Sequence)</td><td>
<ul>
<li>Students create interactive information.Students plan, document and effectively manage processes and resources to produce designed solutions for each of the prescribed technologies contexts.</li>
<li>Distinguish between different types of networks and defined purposes.</li>
<li>They define and decompose problems in terms of functional requirements and constraints.</li>
<li>They evaluate information systems and their solutions in terms of meeting needs, innovation and sustainability.</li>
<li>They analyse and evaluate data from a range of sources to model and create solutions. They use appropriate protocols when communicating and collaborating online.</li>
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Students design and create a plush toy that has various elements connected to a LilyPad with battery and on/off switch.
<ul>
<li>Students discuss the differences between series and parallel networks</li>
<li>Students collaborate to decide how to best design their circuit for their soft toy.</li>
<li>A template of a toy should be drawn so that the circuit can be planned prior to commencing sewing the conductive thread. This example from sparkfun electronics might help.</li>
<li>Students create a diagram flow chart to show connections needed for LilyPad components and the chosen design of the plush toy</li>
<li>Students sew and place LED lights, switches and buttons onto the felt material.</li>
<li>Students test their switch to see that lights turn on and off as expected.</li>
<li>Students evaluate the solution and make improvements as needed.</li>
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<tr><td>Learning input</td><td>
<ul>
<li>The teacher introduces the idea of e-textiles. Some videos on e-textiles that might engage students are;
<ul>
<li>ideas that present the future of clothing and</li>
<li>Interactive wearable clothing from monitoring sleep patterns to physical exercise.</li>
</ul>
</li>
<li>The teacher shares some examples if available of toys that have LED lights that turn on and off during play. A discussion on circuits should be a part of a lesson preparation.</li>
<li>Teacher shows examples of the two differing circuits and introduces students to the Digital Technologies Hub resources introduced earlier that allow students to explore circuits.</li>
</ul>
Allow time for discussion on circuits and the future of clothing that contains some form of circuitry. Look also at smart materials and how they might change the way we dress and think of clothing in the future.<br><br>
Ask students how smart clothing that monitors an individual’s health might be of value.
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| Learning Construction | Teachers should be familiar with circuitry and have some understanding of how to thread and sew with needle and material.<br><br>Have students watch the video on sewing conductive thread<br><br>● Cut out template for toy from felt material keeping mind the size s that the conductive thread does not touch when sewed between switch, button and LED's<br>● Talk about the need to have thread connected to the positive or negative connectors on switches, buttons and LED's and not to cross over. Explain a short circuit.<br>● Once materials are sewn together connect the battery and check to see if button works in turning on and off LEDs.<br>● Determine how this simple project might be enhanced or made more interactive with other components. |
| Learning demo | Students present their finished toys to their peers and then to students in younger classes. |
| Learning reflection | Students might now reflect on the simplicity of the task as it first appeared and look at the limitations of producing e-textiles as possible business.<br><br>How might e-textiles be developed to become a more mainstream product and if an entrepreneur looking to capture a market of young buyers, what might be the hook that captures the interest of someone looking for a new type of clothing? |

**Assessment:**

Formative Assessment

- Observation of student planning and circuit design
- Successful student completion of the online Series Circuit and Parallel Circuit activities
- Class discussion about the difference between series and parallel circuits
- Peer assessment of the finished toy
- Student sketch of their circuit

| | Quantity of knowledge | | | Quality of understanding | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-structural** | **Uni-structural** | **Multi-structural** | **Relational** | **Extended abstract** |
| Diagram | Diagram contains all components of the project.<br><br>Some evidence of labels. | Complete diagram includes labels using correct vocabulary. Eg input/output, LED<br><br>Some notation of changes included. | Diagram is complete, clearly labeled includes symbols and is easy to follow.<br><br>Changes or iterations evident. | Specific vocabulary is used throughout the diagram.<br><br>Proper symbols and explanation key is included.<br><br>Iterations made during the project are documented. | Correctly labelled diagram complete and presented to an excellent standard.<br><br>Complete detail of all connections and hardware including description of components included.<br><br>Iteration and changes documented, including a final reflection. |
| Vocabulary | No specific / technical terms used. | The terms circuit, input output may be used as a general description. | The terms analogue and digital are known and used correctly. | Specific terms such as light sensors, LED, buzzer, program are known and used appropriately. | Understanding of specific terms analogue, digital, program, code, buzzer, button. |
| | | | | | |

# Teacher/Student Instructions:

There is no particular programming task in this exercise. Coding with the Arduino will come in further activities once students have mastered the skills of sewing conductive thread to create circuits.

This is an introductory project for students, many whom will have never threaded a needle or sewn before. Some time and patience will be needed to overcome some of the frustrations that will invariably ben encountered when learning a new skill.

# CSER Professional Learning:

This lesson plan corresponds to professional learning in the following CSER Digital Technologies MOOCs:

- CSER MOOC Next Steps: Module 2.
- An introduction to General-Purpose Programming Languages
- Transitioning from Visual to General-Purpose Programming - Section 2

See: http://csermoocs.adelaide.edu.au/moocs

# Further Resources:

A simple tutorial on how to sew a circuit and connect an LED light LilyPad

Arduino software to program your project

LilyPad Arduino Tutorial with Geekgurl - make a cushion with lights as an etextile project

Sewing basics with Lilypad conductive thread

Beginning LilyPad Arduino instructions.

Introduction to Arduinos referenced from the Digital Technologies Hub an invaluable resource for finding resources.

A tutorial that takes you through the sewing of a lilypad to LED lights for programming on your computer.

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