LED Sculpture Lamp
Created by Jeff Epler

https://learn.adafruit.com/led-sculpture-lamp

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Overview

Inspired by the idea of a curved lamp using LED strips, I created this 3D printable design. Thanks to the adjustable power supply, it is dimmable. To build the full lamp, 3 meters of LEDs are required.

Don't connect a CircuitPlayground to the round perma-proto board in this project. The lamp runs on 12V, which is a high enough voltage to damage a sensitive microcontroller!

Parts

Ultra Flexible White LED Strip - 480 per meter - 5m long

Here at Adafruit we love discovering new and exotic glowing things. Like moths to the flame, we were intrigued by these 'chip on board' ultra-flexible white LED Strips with 480...

https://www.adafruit.com/product/4840
Adjustable Power Supply with 2.1mm / 5.5mm DC - 3V to 12V at 5A
Put your Snap! cassette on and sing along to "I got the power!" with this super useful power supply adapter where...
https://www.adafruit.com/product/4880

Circuit Playground Proto Gizmo - Bolt-on Perma-Proto
Extend and expand your Circuit Playground projects with a bolt-on Perma-Proto that lets you connect solderable circuits in a sturdy and reliable fashion. This PCB looks just like a...
https://www.adafruit.com/product/4320

Breadboard-friendly 2.1mm DC barrel jack
This power jack is designed to fit 2.1mm power plugs snugly and securely. Perfect for adding a power connector to your project. We went for the more expensive "thin pin" type...
https://www.adafruit.com/product/373

Silicone Cover Stranded-Core Wire - 50ft 30AWG Red
Silicone-sheathing wire is super-flexible and soft, and its also strong! Able to handle up to 200°C and up to 600V, it will do when PVC covered wire wimps out. We like this wire...
https://www.adafruit.com/product/3165
1 x In-line power switch for 2.1mm barrel jack
Add a power switch to any project simply by plugging this between the power supply. This is the most useful thing you never knew you needed! You'll want to pick up a bunch...

https://www.adafruit.com/product/1125

1 x White Nylon Machine Screw and Stand-off Set – M2.5 Thread
Totaling 420 pieces, this White Nylon M2.5 Screw Set is a must-have smörgåsbord for your workstation. You'll have more than enough...

https://www.adafruit.com/product/3658

1 x Transparent PETG
Transparent PETG Filament 1.75mm

https://www.amazon.com/dp/B07SB761QR

1 x White PETG
White PETG Filament 1.75mm

https://www.amazon.com/dp/B07PDV9RC8

Tools

I used these tools & consumables when putting the project together. If you've already got something that works for you, use it. If you're just getting started, use this as your shopping list.

1 x iFixit Essential Electronics Toolkit
iFixit Essential Electronics Toolkit
This here is iFixit's most economical do-everything toolkit. The Essential Electronics Toolkit is what you need for the most...
1 x **Flush diagonal cutters**
These are the best diagonal cutters, large super-comfortable grip to use and have strong nippers for perfect trimming of wires and leads. I've used my pair every day for years.

1 x **Simple pliers**
Simple needlenose pliers for twisting, pulling and pliering your project.

1 x **Solder Wire - 60/40 Rosin Core - 0.5mm/0.02” diameter - 50 grams**
If you want to make a kit you'll need some solder. This 0.1 lb (about 50 grams) spool is a good amount, not too much (like 1 lb spools) and not too little (like those little...

1 x **Adjustable 30W 110V soldering iron**
This 'pen-style' soldering iron is just about the best entry-level tool I've seen. It's not as powerful as a Weller WES51 but it is self-contained and easy to...

1 x **Solder wick - 1.5mm wide and 1.5m / 5 feet long**
Used along with the solder sucker to clean up soldering messes. Wick really comes in handy when soldering or desoldering surface-mount parts. Even if you don't have the best iron...

Not an essential tool for this project, but seen in some guide photos:

1 x **Stickvise PCB Vise**
Are you still looking for that perfect PCB holder? The low profile PCB Stickvise might be just the thing you need! In performing the simple task...

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### 3D Printed Parts

The 3D printed parts were designed in a combination of FreeCAD (for the transparent curved parts) and OpenSCAD (for the base & cap parts), because I find OpenSCAD to be a better tool for doing repeated hole patterns, but FreeCAD was better for creating the spline shape of the LED holders. [OpenSCAD](https://adafrui.it/XD4) and [FreeCAD](https://adafrui.it/TFl) are both free and open source programs that run on Windows, Mac, and Linux.
You'll need to print a total of 12 of the LED guides in transparent plastic. I chose PETG, but because as LEDs do not give off much heat, PLA or other types of plastic should be fine. It's important that the LED guides be printed in a transparent or translucent plastic.

I used my slicer's "fuzzy skin" setting to increase the diffusion effect. The LED guides do not need support.

If you have a 210mm or larger bed, the STL file mult.stl has 4 copies of the LED guide, so you would need to print it 3 times. Otherwise, splinelamp-v4-Body.stl contains one copy and needs to be printed 12 times.

The remaining 3 parts need one copy each: There's a top, a bottom, and a middle part. The top and middle parts do need support on build plate only. Flip the side with the hexagonal 'holes' down on the build plate. Make sure to turn off the "fuzzy skin" mode if you used it earlier. I printed these in white, but you could use other colors or even make these out of transparent filament too.

The file plated.stl has these three parts in their correct orientation.
You can print these files with whatever color & material suits you.

To modify the parts, download the design (.FCstd and .scad) files using the button below:

Design files: lamp-design.zip
https://adafru.it/XD6

Also seen in the cover photo: 5 Tetrahedrons in a Dodecahedron (https://adafru.it/XD7) by Kristian_Laholm

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**LED Strip Preparation**

First, remove the silicone tube from around the LED strip. Insert diagonal cutters in the end and cut away the end cap and at least an inch of tubing. Then, carefully remove the whole end cap and separate the LED strip from the tubing. Repeat at the other end. With the 1 meter length, it is now possible to carefully pull the strip out of the tubing. With the 5 meter length, it is probably necessary to slit the whole length of the tubing.

Separate the strip into 250mm sections by counting off 10 of the divisions. Make a clean cut exactly along the dividing lines using diagonal cutters.
Next, for each section, cut a generous length of red and black wire (4 inches is good, but I probably did about 6 inches. This leads to some waste but it's preferable to ending up without enough wire). Slightly strip one end of each wire (even though I keep my fingernails short, they were a good tool for this task; the traditional wire strippers I own were not "up to" dealing with this small and thin wire).

Desolder any original wire (it is way too chonky to be good for this project) and then solder your new wire on: Red on the "12V+" side, and black on the "12V-" side.

It's best to leave the other end of each wire unstripped until soldering it to the Perma Proto board.

Now it's time for the part that needs a lot of care: inserting the LED strip into the 3D-printed LED guides. Identify which side to insert the strip from, and which direction the LED strip needs to face. You'll need 6 strips inserted from each direction; the strips should all face "out".

The first part of the strip will insert easily, but after that there is increased friction. Hold the strip between your index finger and thumb, with your thumb on the plain side of the strip. Push it forward by short distances (a few mm / ¼ inch at a time), being careful not to kink the thin PCB material, until it's all the way through the guide.

While this picture shows some of the original wires, I discovered that these were not flexible enough, and replaced them with fresh wires.
Assembly and Soldering

Count out 24 hex nuts from the box of fasteners. The top and middle pieces each have 6 spots for horizontal nuts and 6 spots for vertical nuts.

If the "horizontal" nuts are a bit loose, you can put a small piece of masking tape over them so they don't fall out for now. Remove the tape when assembly is complete.

For the "vertical" nuts, it's important that they be well-centered with respect to the holes in the 3D prints. You can press them in by taking advantage of a hard surface like a table, and then use one an M2.5 screws to make sure that they are centered before continuing to the next step.
Next, solder the barrel jack onto the perma-proto board. You must place it exactly in the position shown, with the front pin in the top row, the rear pin in the 4th row, and the middle/side pin in the third row.

Bend the top pin down, the bottom pin up and the side pin right.

Using a small piece of wire, create a connection from the top pin to the topmost pad with the blue line to its right.

This will connect the power supply's positive side to the red (positive) rail and the negative side to the blue (GND) rail.

The Perma Proto is shown here on top of the bottom 3d printed piece, but at this point you should not screw them together. It's good to check the base part for correct fit, though, it could save you a tricky unsoldering operation later.

Instead, set the bottom piece aside and bolt the middle piece to the perma-proto in the orientation shown. You won't have enough screws to fill all 8 positions, but 2 or 3 provide an adequate mechanical connection.

The photos below show all the LED segments bolted on at the start of the soldering process. However, the recommended procedure is to start with just two segments bolted on.
Grab some of the middle length (M2.5x6mm) screws from the fastener pack.

Pick two LED strips of the correct orientation to go in the north and south positions and screw them in to the base piece and then into the top piece.

Take the red wire of the south piece and "thread" it through the bottom hole just to the right of the red line. Take the black wire and thread it through the bottom hole just to the left of the blue line.

Flip the board over, pull the wires completely through, and trim them to about ¾" length with side cutters.
Then, grip the bottom part of the black wire with pliers and use your fingernails to strip the insulation at least 1/4" from the end. Push the remaining insulation back through the hole, and solder the exposed wire to the pad. Repeat with the other (red) wire. Trim any excess wire with side cutters. At this point, it's good to test the LEDs by plugging in the power supply and turning it to 10V or more; the LED strip should light clearly along its entire length. Always unplug the power supply before soldering the next strip.

Repeat this process with the rest of the strips, working inward from the north and south ends to the center. When the remaining gap is too small for a hand, use the pliers to guide the ends of the wires into the holes. Be patient, always pay attention to polarity, and test frequently to ensure each strip works when it's added. If a strip doesn't light, the most likely cause is bad soldering; simply de-solder it and start again with fresh wires. In one case the author experienced, the pads at one end of a section didn't work but the pads at the opposite did. The LED strip may have been damaged by careless handling.
Once soldering is complete, the remaining step is to bolt the bottom 3D printed piece to the perma/proto. Like the middle piece, there won't be enough screws to bolt all the positions, but 2 or 3 positions are enough to give adequate mechanical strength.

Use the variable power supply to adjust the brightness, and add an in-line switch if you want to turn the lamp on or off with a decisive click.

**Take it Further**

Want to hone your own 3D design skills? The author ran out of time to design a snap-in cap piece that would hide the wires. Maybe you'd like to try your hand at it. A version that is designed for hanging from the ceiling would also be excellent.