

## Project 1: Solar Lamp (Proto-Page)

This lesson will teach you how to design and build your own rechargeable solar lantern!

### Optics and Building the Lamp

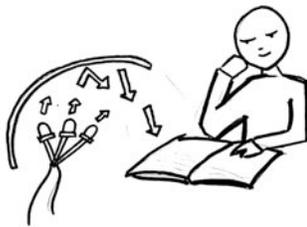
The first step is to consider the structural design of the lamp – and then build it! To improve the lighting, we can also consider reflectors and other additions. The design of your lamp should be guided by the function you want it to perform – but have fun with the design, and be creative!

### Designing the Structure

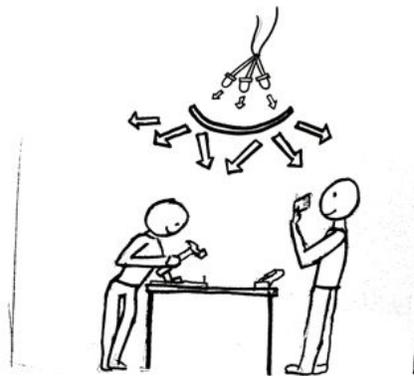
The shape of your lamp will depend on what you'll do with your lamp. Do you want a lamp to hang on your wall? You will need to make a string or a hole so you can attach it. Make sure that your lamp is strong enough to hang on the wall!

If you want a desk lamp, the light must be high enough to shine down on your books. The neck of the lamp should be firm enough to stand up without flopping over. The higher the neck, the stronger the base of the lamp must be to support it. A good base is *wide* so the top of the lamp can balance, and *heavy* so the lamp doesn't tip over.

You should also consider where you want your light to shine.



Is this a desk lamp, to light up one book?\_



Or a lamp to light up the whole room while you work?

Here are some questions to think about:

- How bright do you want your light?
- Where should your lamp point?
- How much space should it light up?

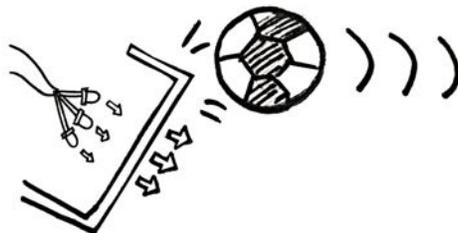
You can change how many LED's you use, but there are many more ways to design a lamp. If you only want the light to shine downward, consider putting a cover or lampshade over the top of the lamp so it doesn't shine into your eyes.

You can also use the properties of light to change how your lamp shines!

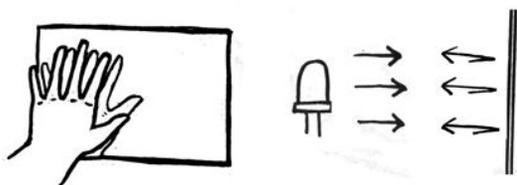
## Reflection

Try shining your light at a mirrored surface. What happens?

Light is a form of energy, like heat. If you shine light on a mirror, the mirror will reflect light back at you— like if you kick a soccer ball at the wall and it bounces back.



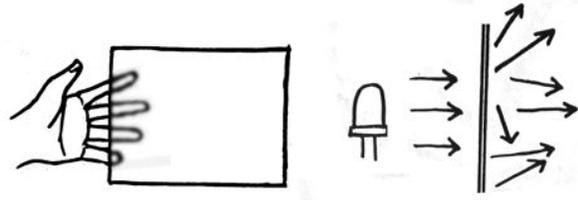
So if you want to make your lamp brighter, you can reflect the light with mirrored surfaces. Many lights have metal domes around them, so the light bounces around and shines out brightly.



## Diffusion

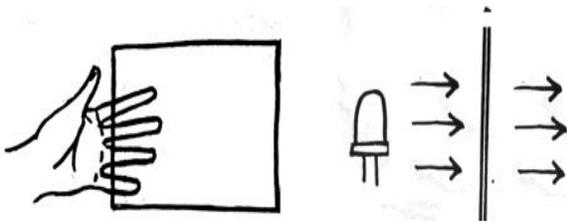
Shine an LED through a piece of paper and compare that to the light cast by a single bare LED. Pay attention to how much more space is lit up with the paper diffuser.

When you shine an LED on a thin piece of paper, the light reflects off the particles inside the paper and bounces around in different directions. This is like kicking a soccer ball at an uneven wall, so you don't know where it will bounce back— except light is made up of many different waves, so you have dozens of balls bouncing around.



With thin paper, much of this light comes through to the other side instead of getting reflected back. You can put paper or another diffuser material in front of your LED to spread out the light in more directions. A diffuser must let enough light through, but it can't be completely transparent— or else the light will continue in the same direction instead of getting reflected. If you have three LEDs, a diffuser could make your lamp shine like one light instead of three separate lights.

What other materials might make good diffusers?



## Transparency

Some materials are completely transparent, like clear glass and plastic. These materials are good for protecting your LED, because light travels straight through without changing direction.

What materials do you have available that would be good to protect your LED?

## Scattering

Try this: shine an LED into a full bottle of water. The water particles both magnify the light and scatter it all around, so you can light up an entire room with one water bottle.



## Continuing On

Now that you've designed your lamp, try building it! You can experiment with different designs if you're not sure which you like best. Have fun with it!

## Future Projects

What else could you charge using a solar panel? How could you adapt your lamp for use in a home kitchen? How about in a school? Try designing a new structure for your lamp, to make it a modular lighting system for use in schools.

When thinking about other projects, try to find applications where solar light is most beneficial. For example, if your school is only in use during the daytime, perhaps you could use the optical properties described above to redirect natural light into the room, instead of converting it into electricity first. How might you do this?

## Coming up next...

- Build a switch and battery pack for your lamp
- Make a solar panel to charge your lamp battery
- Learn more about photovoltaics!