Nine Quick and Easy Laser Experiments to Share with Your Kids

By Aurora Lipper

The word "LASER" stands for Light Amplification by Stimulated Emission of Radiation. A laser is an optical light source that emits a concentrated beam of photons. Lasers are usually monochromatic – the light that shoots out is usually one wavelength and color, and is in a narrow beam.

By contrast, light from a regular incandescent light bulb covers the entire spectrum as well as scatters all over the room. (Which is good, because could you light up a room with a narrow beam of light?)

There are about a hundred different types of atoms in the entire universe, and they are always vibrating, moving, and rotating. Think of kids on sugar. When you add energy to these atoms (even more sugar to the kids), they really get excited and bounce all over the place.

When the atoms relax back down to their "normal" state, they emit a photon (a light particle). Think of the kids as coming down from their sugar high, and they all collapse on the couch.

A laser controls the way energized atoms release photons. Imagine giving half the kids sugar, and picture how they would bounce all over the place (like light from a bulb)when it took effect. They would be very high-energy among the other half who were contently sitting down.

Now imagine those sugar kids jumping in unison (a focused laser beam). The sugar-kids are infectious, and pretty soon, the kids around them are joining in and sharing in their excited energy. This is how a laser charges the atoms inside the gas medium.

Now imagine a cat-flap that lets out a limited number of kids out at a time, while the rest are bouncing around inside, charging up everyone. That cat-flap exit is the laser beam exiting the laser. The atoms remaining inside the laser bounce off mirrors as they charge each other up.

Before we start, you'll need eye protection – tinted UV ski goggles are great to use, as are large-framed sunglasses, but understand that these methods

of eye protection will not protect your eyes from a direct beam. They are intended as a general safety precaution against laser beam scatter and spinning mirrors. (Yes, you will be wearing sunglasses in the dark!)

A very neat addition to the experiments below is a fog machine. (Rent one from your local party supply store.) Turn it on, be sure you have good ventilation, darken the lights, and turn on the lasers for an outstanding laser experience!

A quick note about lasers: keychain lasers from the dollar store work just fine with these projects. Do *not* use the green lasers sold in astronomy stores – they are too dangerous for the eyes.

Plastic Bottle Beam Fill up a plastic water or clean soda bottle with water and add a sprinkle of cornstarch. Turn down the lights and turn up the laser, aiming the beam through the bottle. Do you see the original beam in the bottle? Can you find the reflection beam and the pass-through beam?

Light Bulb Laser In the dark, aim your laser at a frosted incandescent light bulb. The bulb will glow and have several internal reflections! What other types of light bulbs work well?

CDs Shine your beam over the surface of an old CD or DVD. Does it work better with a scratched or smoother surface? You should see between 5-13 reflections off the surface of the CD, depending on where you shine it and how good your "seeing" conditions are.

Glass and Crystal Pass the laser beam through several cut-crystal objects such as wine glasses or clear glass vases. Is there a difference between clear plastic or glass, smooth or multi-faceted? Try an ice cube, both frosted and wet.

Microscope Slides Shine the laser beam through a flat piece of glass, such as a microscope slide or single-paned window. Can you find the pass-through beam as well as a reflected beam?

If you have it, fill a clear tank with water, add a sprinkling of cornstarch, and put the slide underwater. Shine the laser through the side wall through the slide and both beams will be visible.

Lenses If you have an old pair of eyeglasses, pop out the lenses and try one or both in the beam to see the various effects. Try one lens, and then try two in line with each other to see if you can change the beam.

Filters Paint a piece of cellophane or stiff clear plastic with nail polish (or use colored filers) to put in the laser beam. You can make a quick diffraction grating by using a feather in the beam.

If you have polarizer filters, use two. You can substitute two sunglass lenses – no need to pop out the lenses – you can just use two pairs of sunglasses. Just make sure they are polarized lenses (most UV sunglasses are). Place both lenses in the beam and rotate one 90 degrees. The lenses should block the light completely in one configuration and allow it to pass-through the other way.

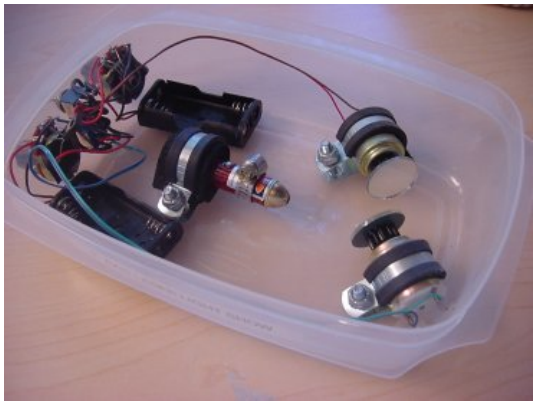
Laser Maze Hot glue one 1" mosaic mirror (found at most craft stores) to each wooden cube. In a pinch, you can use aluminum foil or Mylar. Add a fog source, such as a fog machine or nearby dry ice – just be sure to have proper ventilation, as you will also need the room to be very dark. Turn on the laser adjust the cubes to aim the beam onto the next mirror.

Laser Light Show What happens when you shine a laser beam onto a moving mirror, as opposed to the static mirrors in the above "Laser Maze" experiment above?

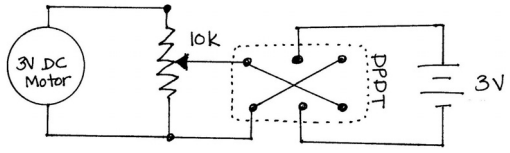
Prepare the mirror-motor assembly by cementing with epoxy the small gears onto the motor shaft (don't glue the shaft to motor – you want shaft the spin!) Spend time making this connection solid, as the motors are going to twirl the mirrors around 3000PRM, and you don't want spinning glass around any eyeballs. You can add the mirror to the flat side of the gear with epoxy at the same time if you prefer. (I use 5-minute 2-ton epoxy myself.)

Once the motors are built, plug them to batteries so the mirrors spin. Turn down the lights and crank up the laser, aiming the beam onto the motor. Shine the reflection somewhere easy to see, like the ceiling.

If you're adventurous, add a second mirror to this system. Is it tough to hold it all in place? If you are the do-it-yourself type, grab a clean Tupperware and mount your laser light show inside and cap with a lid. (Hint: use pipe clamps to hold the motors and laser, and mount on the side of the container.)



You can add potentiometers for a quick motor control as shown below and DPDT switches with a "center off" position to reverse the motor direction.



Why Does It Work? If you haven't figured this out yet, I will give you a hint: imperfections.

This Laser Lightshow works because the mirrors are mounted off-center, the motors wobble, the shafts do not spin true, and a hundred other reasons why our mechanics and optics are not dead-on straight.

And that's exactly what we want – the wobbling mirrors and shaky motors make the pretty pictures on the wall! If everything were perfect, it would not work well. Just be sure to put the lid on before you spin up. Enjoy!

Since 1996, Aurora Lipper has been helping families learn science. As a pilot, astronomer, engineer, rocket scientist, and former university instructor, Aurora can transform toilet paper tubes into real working radios and make robots from junk in the back desk drawer.

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