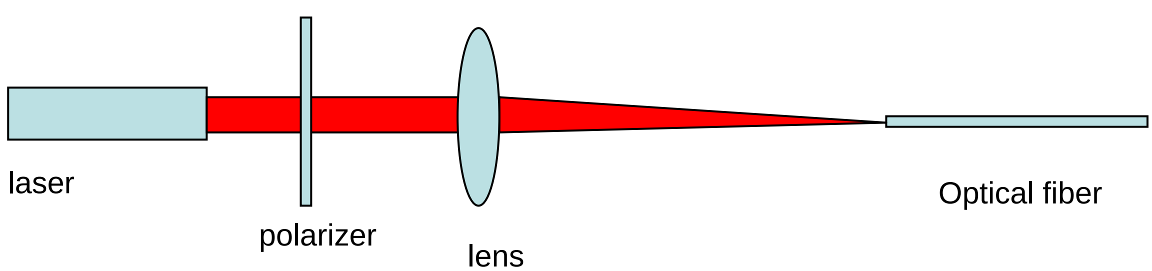
Lab: Optical Fibers

Parts (Approximately)

1	RCX 1.0
1	Locking Gear System
1	Sensor
1	6 x 12
1	6 x 14
8	1 x 12
13	1 x 8
11	1 x 6
3	2 x 8 (thin)
3	3 x 6 (thin)
6	2 x 4
2	2 x 4 (thin)
5	2 x 2
4	1 x 10
2	Gears
	Rods
	End caps
2	Lens f = 50mm and f =17mm

Purpose

The main goals for this lab are: a) to see how the specifications of a lens affect the size of the spot that we can focus a laser beam to, and b) to couple light into a fiber and see how efficiently we are able to do that depending on the optics. So, the set up you will building will basically look like that:

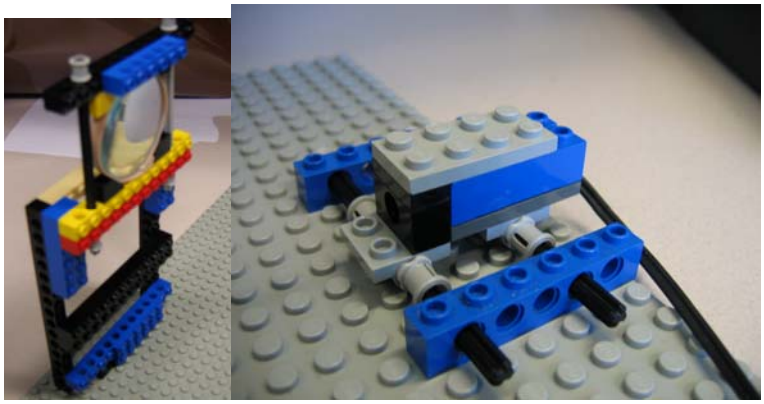


You will need to make a three dimensional stage for your optical fiber so that you can accurately and in a stable fashion control the position of your fiber so that you can optimize how much light you get through it.

Procedure

1. Mount the laser so that it stands about x cm from the table. See schematic under step 7.

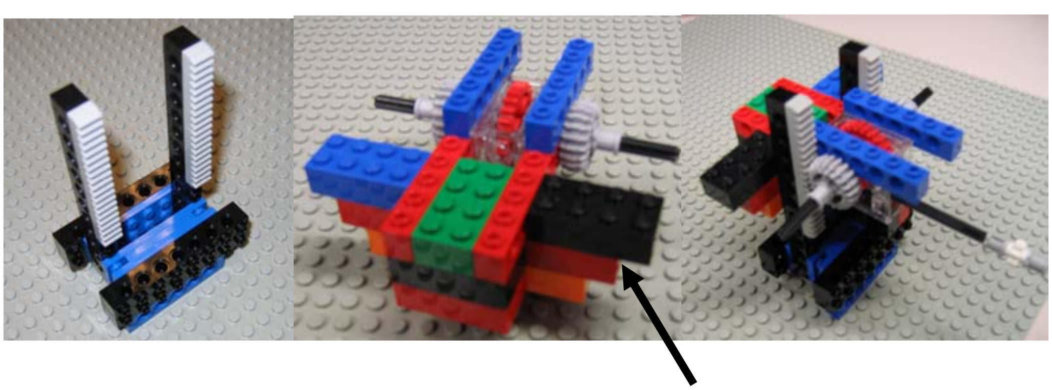
2. Place the two polarizing filters in front of the laser. Use the same mounts that you made in last lab. Orient the filters such that the intensity of the laser beam is reduced. Measure the intensity using the LEGO detector by attaching it to Port 1 on the RCX and hitting the “View” button on the RCX to see the intensity value. The RCX should read a value in between 70 and 95. If it reads 100, you are oversaturating it. In that case adjust the filters to get it to read in the 70 to 95 range.



3. Next, place a f=17cm lens after the filters.

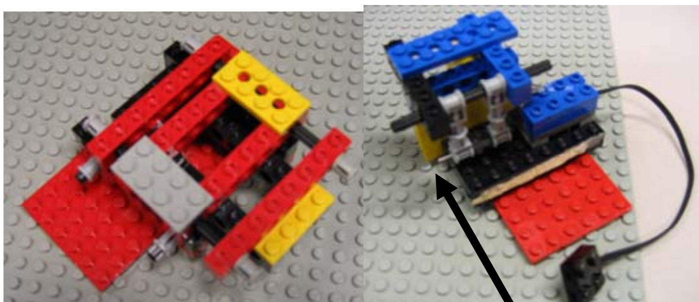
4. Measure the intensity at the focus. Measure the intensity using the LEGO detector by attaching it to Port 1 on the RCX and hitting the “View” button on the RCX to see the intensity value. Remember to put a lego piece in front of the detector to limit ambient light.The RCX should read a value in between 70 and 95. If it reads 100, you are oversaturating it. In that case place one or two polarizing filters in front of the laser beam so that your sensor reading is in the 70 to 95 range.
5. Intensity = ________
6. Measure the size of the spot. Is it consistent with the expression we talked about in class and that is in your book in terms of its relationship with the focal length and diameter of your lens? (Hint: since you are not filling the lens with your laser beam you should consider the diameter of your beam)

7. Now we are going to build the foundation for the translational stage. Start with two pillars and attach gear slots and anchor them down to the surface. Next create the cart that will move the stage up and down in the z direction. Make sure the cart has a back support for the stage. Once finished the cart should stable and perpendicular to the foundation pillars.



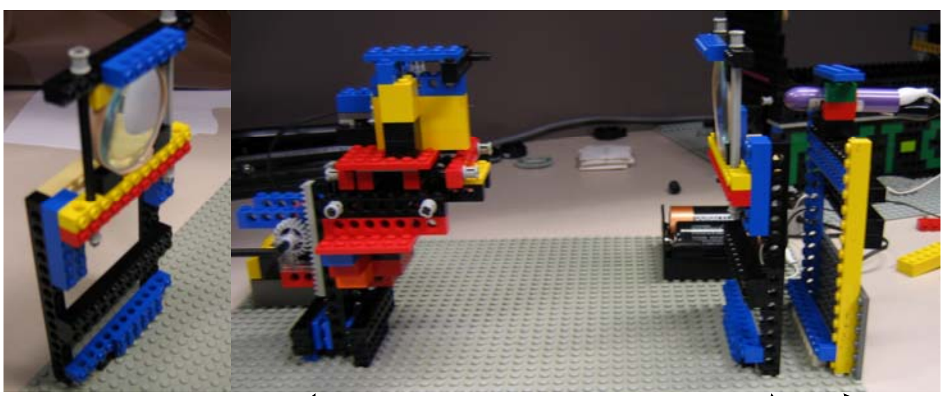
Back support

8. For coupling of light into the fiber, both x and y translation are needed. You must stack moveable stages using rods and end pieces to allow free movement in both the x and y directions. (hint: the rods will provide the guides for the movement.) In order to couple the light into the fiber, you must also steer the fiber into the detector. Make sure to polish the surface of the fiber using the paper we supplied. Use mounting bracket to secure the fiber into place. It is important to secure the fiber using foam to the inside the mounting brackets.



Fiber

9. Now place the mounting bracket and the x and y translational stage onto the cart to create a 3D translational stage. Now place the lens mount in front of the fiber and then place the laser mount behind the lens. Make sure the fiber is at the focus point of the lens using the translational stage to align the laser.

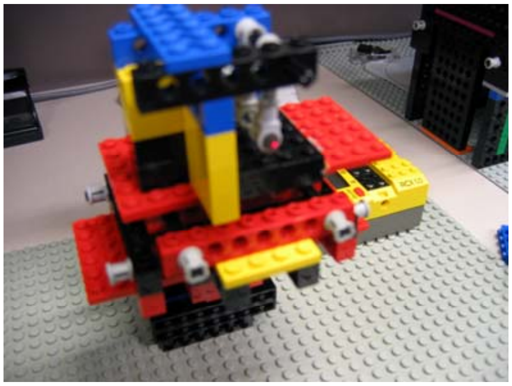


17cm

Translational Stage Lens Laser Mount

10. Measure the highest intensities from the ambient light, the laser focused on the detector and the laser coupled through the fiber. Try moving the stage in different directions to maximize the intensity from the laser (on axis).

$Intensity_{amb}$ = _________ $Intensity_{laser}$ = _________ $Intensity_{coupled}$ = _________



11. Now replace the lens with the 50 mm focal length lens. Measure the size of the spot and the power and compare them to your measurements with the other lens. Are they different, similar and why?

12. Place your fiber at the focus of this lens and measure the light that makes it through the fiber this time. Is there a difference from your previous measurement? Why yes or why not?