

An Inexpensive Optical Bench for TI Light Sensor Experiments

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Revision 0

INTRODUCTION

In the past, I tried to demonstrate the inverse square law by having my students perform experiments described in Texas Instrument's Experiment Workbook, Vernier's Physical Science with CBL(by D. L. Volz and S. Sapatka), and Vernier's Physics with CBL(by J. Gastineau, K. Appel, C. Bakken, R. Sorensen, and D. Vernier). I found the apparatus described to be difficult to use and the results unsatisfactory. In an attempt to improve the experimental practice and results, I devised the inexpensive optical bench described below. Although the data I have obtained are more reproducible and more closely approximate the inverse square model, because I have a limited number of light probes to experiment with, I cannot predict with certainty that you will achieve comparable results. I did find that several of the construction and procedural details are critical. These items will be noted below.

Construction of the apparatus requires inexpensive and readily available tools and materials. The design is similar to the apparatus displayed at <http://www.omni-optical.com/l-optics/sl205.htm> but avoids the specialized metallic fixtures. Figures 1 and 2 show the side and overhead views of the apparatus.



Figure 1

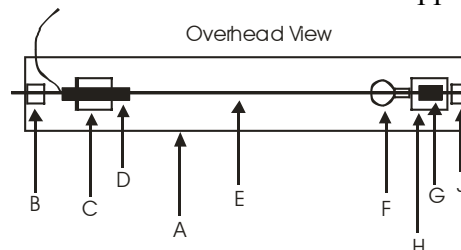


Figure 2

- A. Base
- B. Left meter stick support
- C. Light sensor slider
- D. Light sensor
- E. Meter stick
- F. Flashlight bulb
- G. Battery holder
- H. Light bulb slider
- J. Right meter stick support

MATERIALS LIST

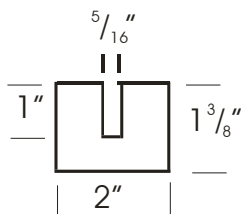
1. Wood 2"X 4". Length depends upon how many apparatus you are making. Home Depot, 8' length =\$2.04
2. Wood 1"X 4". Length depends upon how many apparatus you are making. Home Depot, One 8' length =\$2.19
3. Wood 2"X 2". Length depends upon how many apparatus you are making. Home Depot, One 8' length =\$1.97
4. Flashlight bulb (F), 2.47V, unfocused. Radio Shack, #272-1132, \$1.49/2
5. Light bulb base. Radio Shack, #272-0357, \$1.59
6. AA battery holder(G). Radio Shack, #270-0408, \$1.49
7. Screws for Light bulb base and battery holder. Flat Phillips 4X3/4 Wood
8. Two AA batteries.
9. Electrical tape.
10. Black construction paper.
11. Meter or yard stick. Note! Check the thickness of the meter or yard stick **before** cutting the wood.

TOOLS LIST

1. Saw. Either hand, or preferably, a chop or miter saw.
2. Drill.
3. Screw drivers.
4. Drill bit 1/8".
5. Drill bit 5/8".

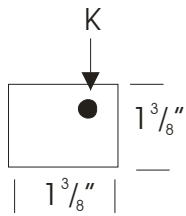
CONSTRUCTION PROCEDURE

1. Cut the base (A) from 1"X 4" wood. The length is not critical.
2. Cut two 2" pieces (B and J) from the 2"X 2" wood. Note! Although the wood is sold as 2"X 2", it is actually 1 3/8" X 1 3/8".
3. Measure both pieces as shown below in Figure 3 and cut the notch cut with a saw. The width of the notch depends upon the thickness of your meter stick. My meter stick from Frey Scientific, required a 5/16" width.



B,J
(Front View)
Figure 3

- The hole drilled at "K" in Figure 4 with a 1/8" drill bit is optional. A bolt or nail inserted through the hole acts as a stop for the meter stick and helps to hold it in position.



J
(Side View)
Figure 4

- Cut two 2" pieces from the 2"X 4" wood. Cut the notch in both pieces as shown below in Figure 5.

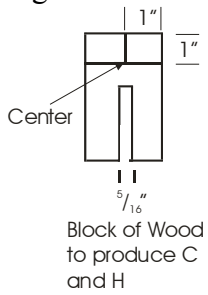


Figure 5

- Align the notches of the two pieces and at the center point indicated, drill a 1/8" hole through the front piece and partially through the back piece. This process ensures that the light sensor and the light bulb are aligned.
- Take the front piece and drill a 5/8" hole through the wood. Do this on a drill press or carefully position the hand drill to ensure the hole is straight. The front piece should resemble Figure 6.

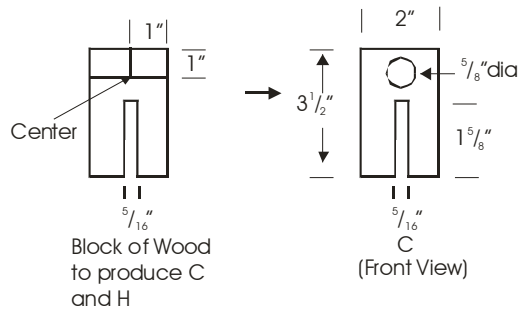
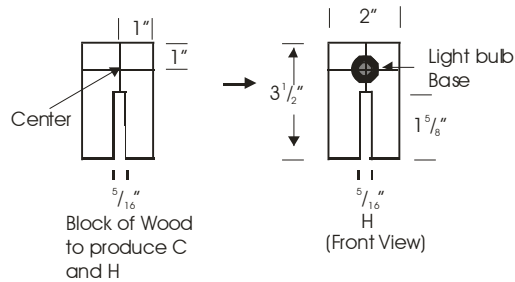
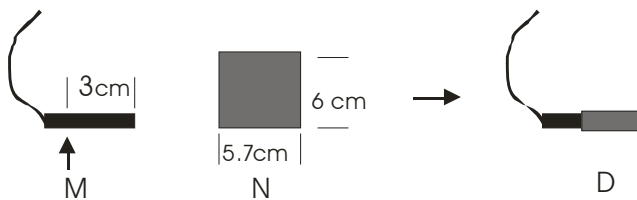


Figure 6

8. Take the back piece and draw two lines through the center of the $1/8''$ hole so that the flashlight bulb holder will be centered. Center the bulb holder and attach with the #6X $1/2''$ metal screws as shown below.



9. To exclude extraneous light from the light sensor, form a tube from black construction paper and slip it over the front of the taper as shown and described below.



Place a mark (M) on the light sensor exactly 3cm from the end. Cut a piece of black construction paper (N) exactly 5.7 cm long and about 6 cm wide and then wrap the paper around the sensor so that the edge is at “M”. The reason that the paper is 5.7 cm long is because the sensor element is 0.3 cm from the end, hence the end of the paper nearest the bulb is exactly 3 cm from the sensing element. If the light bulb’s heating element is positioned at 0.0 cm on the meter stick and the end of the paper tube is at the 1.0 cm on the meter stick, the distance from the light bulb’s heating element to the probe’s sensing element is exactly 4.0 cm. Thus, for this data point you would use 4.0 cm in your intensity vs. distance calculations.