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Liquid Drop Microscope

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Liquid Drop Microscope

By Larry Browning, SDSU Physics Department

Caution: This project uses a laser. Laser light can damage the retina of an eye so be careful that the beam is not directed or reflected into an eye. For safety reasons, a low power laser (Class IIIa, under 5 mW or lower) is recommend.



Figure 1 Parts for Liquid Drop Microscope with a 6" ruler for scale.

Did you ever wonder what was living in a drop or pond water, or in your dog's water dish? Here is a great way to find out for not a lot of money or time. The goal is to suspend a drop of water (or other transparent liquid) in the path of a laser and look at the light projected on a wall or white surface. Of course, it also helps to be able to change the angle that the laser is projected so the scene is elevated a bit. This microscope does all of that and is affordable, easy, and can be assembled in a few minutes. Several ways of doing this have been suggested (for example: <http://makezine.com/projects/make-36-boards/laser-projection-microscope/> or on You-Tube: <https://youtu.be/lZiZMcMxQg>) but this is one design that I've had some success with in classes and workshops.

On a base of wood approximately 4"x 4" (the picture shows a scrap of baseboard cut to a 4" width, a flooring sample also works well) glue a wooden clothes pin parallel to and near the middle. This will be the holder for the laser and also serve as the "on" switch. On a side parallel to the clothes pin drill two holes for the 4" long dowel pins. One hole should be near the corner and the other a little past

half way so that a laser held by the clothes pin will point between the dowel pins. You may want to make the holes just slightly bigger than the diameter of the dowel pins. The idea is to have the dowel pins fit snugly but still be able to slide in the holes to adjust the angle of the beam of light. For the model pictured, the holes were $13/64$ " in diameter for 4" long dowel pins that were labeled as being $3/16$ " in diameter – of course wood is a natural material that does shrink and swell.

After inserting the dowels in the holes you have an adjustable stand and holder for the syringe. A rubber band wrapped around both dowel pins a few times will hold a syringe filled with your sample in place. The tension in the rubber band will also keep the dowel pins from slipping should the holes be a little too big.

The hard part is adjusting the syringe so that a drop of the water (or fluid) is in the laser beam. This is a little tricky, but with a little patience and steady hands, you will be rewarded with a magnified and live view of the contents of your sample. Be careful! Do NOT look in the laser beam directly or reflected from a shiny surface. Remember the laser is incredibly bright (although at one color only) and can easily cause permanent damage an eye that is exposed to it. To see where the laser beam is, in relation to the tip of the syringe, you can use your finger or a card as a "screen" holding it near and behind the syringe tip from the laser. That way you can see which way you need to move the syringe.

To keep expenses to a minimum, a "pet exerciser" laser (red) can usually be found near the cat food for about \$2 or even from a dollar store for a dollar. A syringe can be obtained from your pharmacist (they often give them to customers to administer medicine to infants) or at a farm supply store (for vaccinating cattle). Dowel pins are at the lumber or craft store as well as 1" x 4" lumber (or something thinner – like sample of flooring). A green laser appears brighter and can project a bigger image, but the cost increases significantly and are more difficult to obtain.

The magnification depends on the closeness of the screen to the drop. Planinsic (2001) calculated that a screen two meters (six feet) from a drop of 2 mm diameter will magnify the contents 1000 times or more (see the reference below for details). With a red laser, it is difficult to be that far from the drop so the magnification would typically be less, but still impressive. Also a dark room is essential regardless of the color of the laser. At this magnification you can easily see diffraction patterns around paramecium and other small creatures or features. The interference and diffraction fringes do make the images less sharp, but that is a good lesson in physics (as well as biology).

Besides looking at microbes in water, why not try other liquids, like oil. Investigations of the optical properties of various oils could be carried out, and even used motor oil could be studied ("How big are the impurities there?"). One warning, if you test tap water you may not want to drink from the tap again. Remember it is safe, but that doesn't mean it is lifeless.

Reference: Gorazd Planinsic, "Water-Drop Projector," *The Physics Teacher*, vol. 39 (Feb. 2001, p. 18) available at: <http://www.fmf.uni-lj.si/~planinsic/articles/planin2.pdf>



Figure 2 Assembled microscope

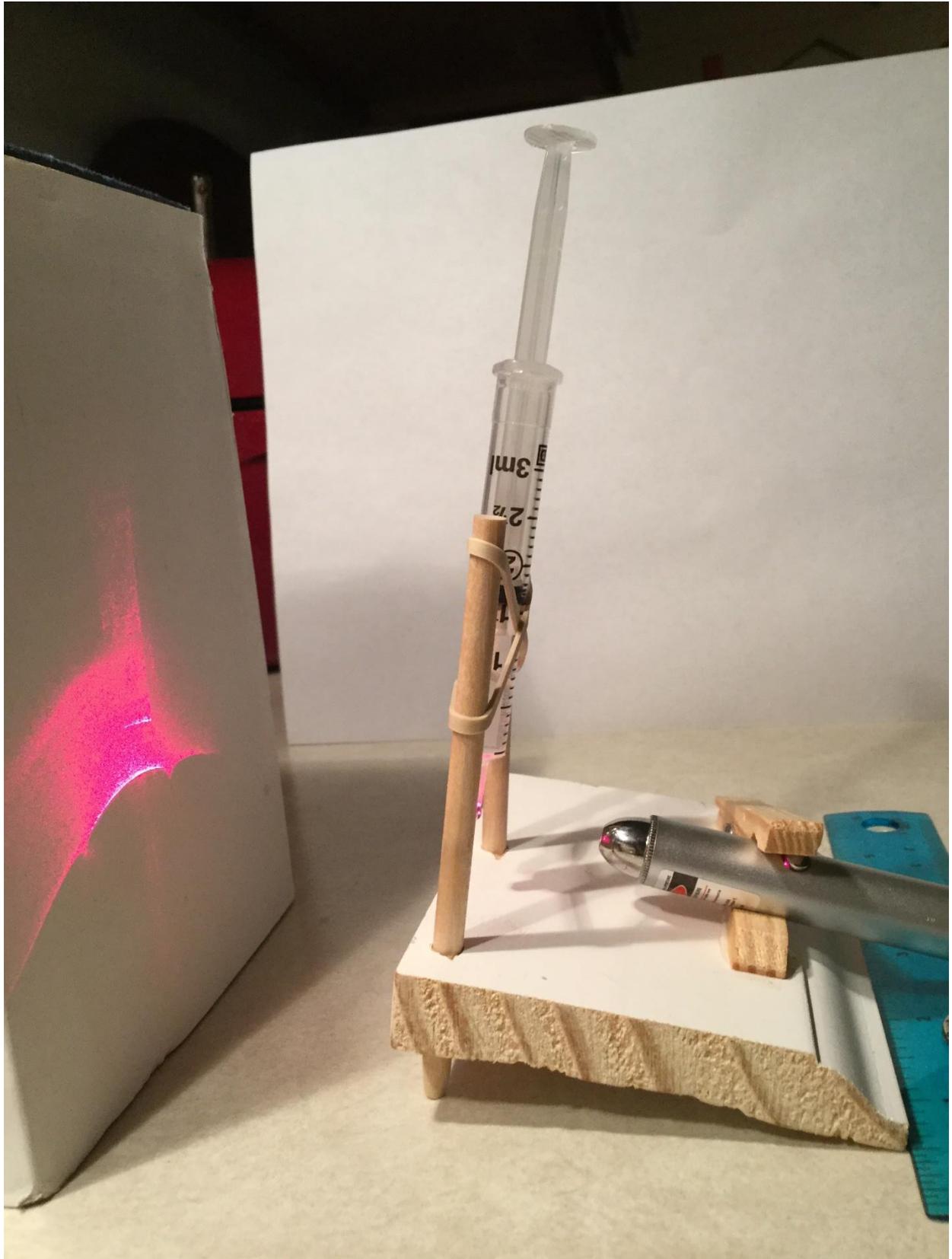


Figure 3 Side view of assembled microscope.