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Total internal reflection in a stream of water - an old, but still amazing, demonstration that can now be performed with ease using only a modern clear plastic bottle and a laser pointer; there is no excuse not to show it. The concept was a major step toward modern fiber optics. If you could "trap" (contain) light in a stream of water, think what you could do with light in solid glass or plastic with solid walls. See (a).

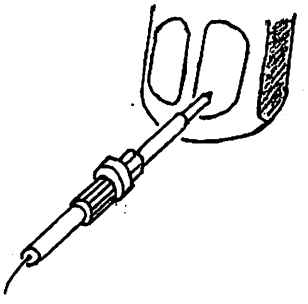
Construction: Any clear, 2 qt. or 2 l. plastic bottle will do. (I prefer the 2 qt. Gatorade bottle or jug.) Set the jug in front of the laser pointer, keeping its beam near the bottom. Aim the beam directly across, from one (flat) side to the other, making 90° with each side. When you are satisfied with an optimum light path, mark the spot where the outlet hole should be. For best results, a "clean", smooth aperature is required. I found that a standard, pencil-type soldering iron with a 4 mm (5/32") dia. tip makes a nice hole. You must let the iron heat up to its maximum temperature before you attempt to puncture the jug. (Test it out on a spare jug first; it should puncture easily without pressure.) The plastic will melt and form a smooth (doughnut) ring around the hole. This will allow for a smooth, glass-like stream of water from the jug. Before you heat up the tip, however, use some steelwool to clean off any old, dirty flux material that could contaminate the plastic and "rough up" the aperature. An alternative method is to use a well-heated, 10 penny nail to puncture the plastic. Before heating, however, file off any burrs on the nail's point. See (b).

Presentation: Place a piece of masking tape over the hole and fill the jug with water. Place the jug on a stand with the laser beam passing through the water and striking the center of the hole and tape. (I use a plastic flower box to catch the water.) With the room well-darkened and the students up close, quickly remove the tape and watch the stream. Insert your hand into the stream and see it light up. Move your hand up and down the stream; everywhere the light remains in the stream or very little light (energy) is lost. Fiber optics is here to stay because it conserves energy. The nearly 2 qt. or 1. of water should give you more than enough time to study the phenomenon. Near the end when the stream is too "bent", the light may "escape". Now is the time to go back and study the meaning of "critical angle"! Fill up the jug and repeat, if necessary. This is just another simple demo that beautifully demonstrates the concept(s) under study. See (c).

Diagrams:

(a) light inside a stream of water

(b) making the hole in the jug



(c) the final set-up