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Question 1: Losing Weight; Question 2: Shampoo Bottles

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Visualization of four optics phenomena in a single experiment

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Laser pointers and compact discs (CDs) have been used since the 1990s for simple optics demonstrations.^{1–5} The use of a laser pointer, a glass of water with a few drops of milk, and a mirror allow us to show the phenomena of reflection, refraction, and total internal reflection of light, while the use of a laser pointer and a CD allows us to show the phenomenon of diffraction. In this work we describe a simple and cheap experiment in which the four previous optics phenomena can be visualized at the same time. The experiment makes use of a green laser pointer (typical wavelength of 532 nm), a support for the laser, a CD (700 MB of data capacity), a glass tank with a rectangular prism shape (31 cm long, 14 cm high, and 7 cm wide, that can be closed at the top with a glass lid), water, rhodamine B solution, an incense stick, and a lighter.

Cut a piece of CD about 2 cm wide and 5 cm long, so that the CD tracks are perpendicular to the longer sides. The piece of CD is placed on the bottom of the glass tank, approximately one-third of the length of the base, with the recording part facing upward. A few drops of the rhodamine B solution (or fluorescein dye) are added to the water until it acquires a slightly pink (or yellow-green with fluorescein) color. Being careful not to move the CD, fill half of the tank with the colored water. The incense stick is ignited and inserted, holding it with one hand, under the glass lid, in the upper half of the tank. Wait a minute for this half to fill with smoke. The incense is removed (care must be taken so that no ash falls into the water) and the lid is placed so that the smoke does not

Fig. 1. Visualization of the set of rays of the experiment.

come out. The laser is held in a support, switched on, and directed towards the piece of CD located at the bottom thereof, through the sidewall of the tank closest to the piece. The laser beam must enter obliquely in the smoke zone about 2 or 3 cm below the upper edge. It is convenient to visualize the tank under low ambient lighting. The result is shown in Fig. 1. The rays in the upper half are visualized due to the diffusion of the light by the smoke. The rays in the lower half are visualized due to the fluorescence of rhodamine B.⁶

References

1. G. Schuttinger, "Laser light show-wet and wild; laser show-quick and clean," *Phys. Teach.* **31**, 375 (1993).
2. G. Adie, "Using the laser pointer as a demonstration tool," *Phys. Educ.* **32**, 190–191 (1997).
3. J. O'Connell, "Optics experiments using a laser pointer," *Phys. Teach.* **37**, 445–446 (1999).
4. J. E. Kettler, "The compact disc as a diffraction grating," *Am. J. Phys.* **59**, 367–368 (1991).
5. H. Kruglak, "The compact disc as a diffraction grating," *Phys. Teach.* **41**, 144–145 (2003).
6. For a quantitative treatment of the phenomena, see the appendix at *TPT Online*, <http://dx.doi.org/10.1119/1.5124295> under the Supplemental tab.

Fermi Questions

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Question 1: Losing weight

How much weight would you lose climbing stairs every day (assuming that neither diet nor metabolism changes in response to the extra effort)? (*Thanks to Alex Godunov of Old Dominion University for suggesting the question.*)

Question 2: Shampoo bottles

The California Assembly voted to ban single-use hotel shampoo bottles. How much impact would this have if it was applied nationwide?

Look for the answers online at tpt.aapt.org under "Browse," current issue. Question suggestions are always welcome!

For more Fermi questions and answers, see *Guesstimation 2.0: Solving Today's Problems on the Back of a Napkin*, by Lawrence Weinstein (Princeton University Press, 2012).

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