Gelatin and the Tyndall Effect: A Colorful and Tasty Demonstration

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Abstract: This demonstration is a safe and nontoxic example of the Tyndall effect that utilizes common, even edible, materials. A glass of gelatin and a laser pointer are used to illustrate the Tyndall effect. Laser light is scattered when it is shone through a colloidal gelatin dispersion. At least two glasses of gelatin are aligned so that students can see scattering through the first glass, then a lower overall intensity of scattered light through the second glass. Variations of the demonstration are presented, such as shining the laser light through a glass of salt water to show the effect as the salt dissolves.

Introduction

The Tyndall effect, the scattering of light through a colloidal dispersion, has been known for over a century and is addressed at least briefly in several general chemistry textbooks [1]. Often, examples are given that involve suspensions of particulate matter, such as dust in the air. A common demonstration has been to clap two chalkboard erasers in a darkened classroom and shine a flashlight through the resultant dusty air to illustrate the light scattering. Although such examples can be useful, various brands of commercially available gelatin are all colloids that can be used to illustrate the Tyndall effect by shining some light source, such as an inexpensive laser pointer beam, through them. This demonstration is inexpensive and quick to prepare, and it must be safer than standing in a room breathing the chalk dust that results from clapping two erasers together.

Drinking glasses, a packet of dessert gelatin, and a small laser pointer are all that are required to set up the demonstration [2]. On the evening prior to performing this demonstration in class, prepare the gelatin on a stove according to the directions on the packet. Light-colored gelatins, such as orange or lemon, tend to work better and produce a more vibrant demonstration than darker colors. Pour the hot gelatin mix into tall drinking glasses, instead of into a pan or bowl. Drinking glasses with a squared-off shape work slightly better than cylindrical glasses. Keep one glass of similar shape empty. When the Tyndall effect is discussed, fill the empty glass with water, line up the water glass and at least two gelatin glasses, darken the classroom slightly, and shine the laser pointer through the three glasses. Students will notice that there is no scattering of light through the glass of water, that there is significant scattering through the first glass of gelatin, and that there is scattering of lower intensity through the second glass of gelatin.

An even easier variation of the demonstration is simply to shine the laser through the two glasses of gelatin. Students can see the scattered light in the first glass and the less intensely scattered light in the second (Figure 1). A second variation of this short demonstration is to add sodium chloride to the glass of water as the laser pointer shines through it. Students will notice a brief period (a few seconds) of minor light scattering, followed by the complete transmittance of light as occurred when the glass was filled with only water (Figure 2). A penlight, in lieu of a laser pointer, can be also be used but students enjoy seeing the effect from a laser pointer far more than just seeing the demonstration performed using white light.

This quick and simple demonstration serves as a starting point for a thorough discussion of the Tyndall effect. Some questions that can be asked and discussed include:

Why does light scatter through the gelatin and not the water, when both are clear?

Answer: The gelatin has particulate matter with dimensions on the order of 1–1,000 nm suspended in it. Particles smaller than this will solvate into the solution, and larger particles will settle out.

Where are the particles, and how are they distributed, in the gelatin?

Answer: The particles are small enough that they cannot be seen with the human eye. They are evenly distributed throughout the glass of gelatin.

Why did the second glass of gelatin appear to have a dimmer beam than the first?

Answer: The first glass scattered a certain amount of the laser light, resulting in less light reaching the second glass; thus, the intensity of the beam in the second glass is lower than in the first.

Why was there a brief period of light scattering as the salt-water solution formed?

Answer: For a brief moment, as the salt solvated, particles of it were of the correct dimensions to scatter light as a colloid does.

What gelatin is composed of and the homogeneity of its dispersion in water is discussed after the demonstration. Additionally, it is pointed out to students that if a certain amount of light is scattered by the first glass of gelatin, the second glass will have less light entering it and thus a dimmer overall beam. As well, the mixing of a solid solute in a liquid (the salt in water) is discussed, and it is pointed out that the solid salt must, for a brief moment, break into small enough particles to scatter light before dissolving completely into solution.

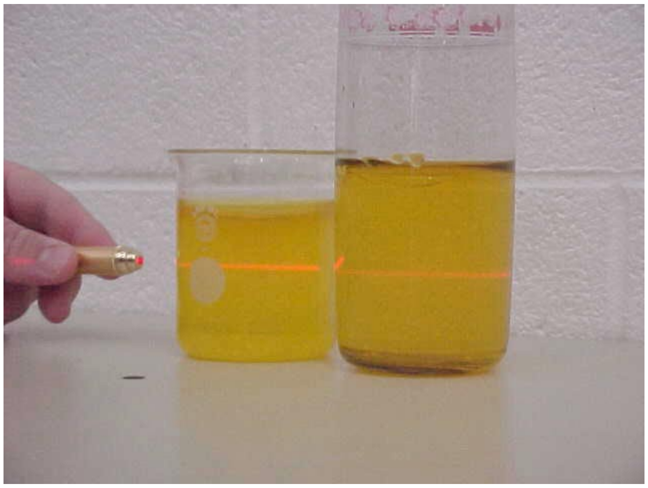

Figure 1. The laser pointer is shone through the two glasses of gelatin. The scattered light in the first glass is more intense than in the second.

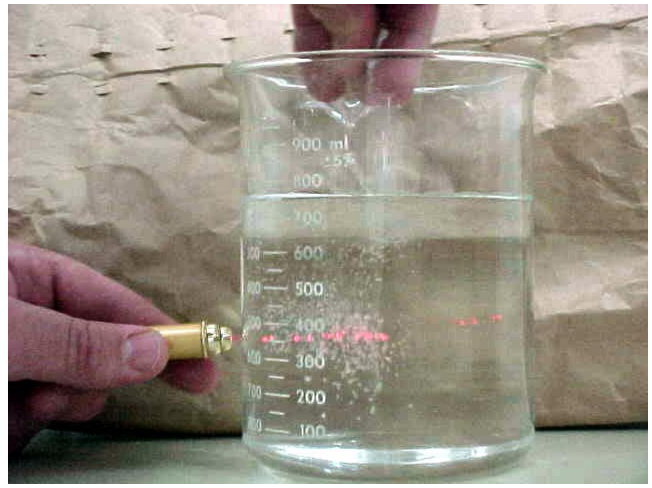

Figure 2. A second variation of this short demonstration is to add sodium chloride to the glass of water as the laser pointer shines through it.

If the class size is small enough, the materials can be passed among the students and they can perform the demonstration for themselves.

Handling and Disposal. Cleanup for this demonstration is as easy as eating the gelatin and washing out the glasses! Do not shine even a small laser pointer into the eyes of any person.

Supporting Material. A short video clip (MPEG format) of the demonstration is available at (http://dx.doi.org/10.1007/s00897000464b).

References and Notes

1. (a) Brady, J. E.; Russell, J. W.; Holum, J. R. *Chemistry, Matter, and Its Changes,* 3rd ed.; Wiley & Sons: New York, NY, 2000, p 560. (b) Hand, C. W. *General Chemistry;* Harcourt Brace College Publishers: New York, NY, 1994, p 545. (c) Hill, J. W.; Petrucci, R. H. *General Chemistry: An Integrated Approach,* 2nd ed.; Prentice Hall: Upper Saddle River, NJ, 1999, p 545.
2. Laser pointers can now be purchased from electronics stores, retail stores, and even gas stations for as little as $15.