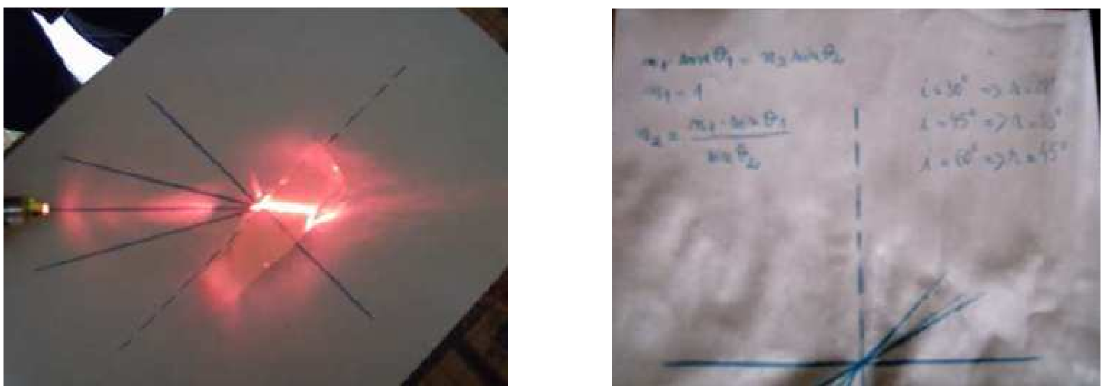
The Index of Refraction of Gelatin

- Objectives: demonstrate Snell's law of refraction, experimentally determine the index of refraction of gelatin, plastic and glass
- Materials: gelatin, laser pointer, protractor, a piece of white paper, a piece of plastic and another of glass
- Procedure: The heaviest but funniest thing to do is to make the block of gelatin. The object is to have a rectangle of gelatin about at least 2 cm thick and 4-5 cm square. The length is not too important, but the edges that light will travel through need to be very straight and flat. ; if you are not a patient man, use a piece of plastic or glass.

We will need a piece of paper with optical axis, the normal and three angles of incidence of 30, 45 and 60 degrees drawn with a pencil. The laser must be directed so that the beam enters the gelatin at (above) the point where the normal line meets the surface, and we must note the point where the refracted beam exit on the other side, measured the angles of incidence and refraction, using the protractor from the normal line. I used Snell's Law $n_1\sin\theta_1=n_2\sin\theta_2$ to calculate gelatin's index of refraction of gelatin, plastic and glass.

Additional, you can make a gelatin "prism" (triangle) and see how some incident angles lead to total internal reflection at the opposite side, an optical "fiber“ or lens shapes.



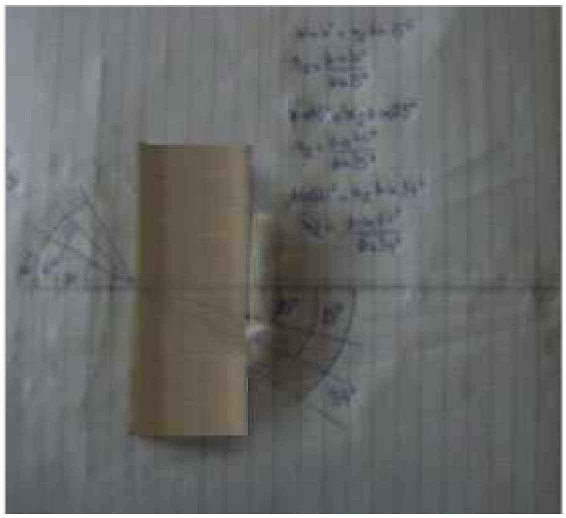
experimentally determine the index of refraction of gelatin

total internal reflection in a plastic “prism” and in a gelatin optical “fiber”

I labeled the dots for each trial, I drew lines connecting the dots, and I measured the angles of incidence and refraction, using the protractor from the normal line. I used Snell's Law ($n_1\sin\theta_1=n_2\sin\theta_2$) to calculate gelatin's index of refraction, knowing that, for the air $n_1=1$.
Here are the results:

θ_1	θ_2	calculated index of refraction	medium gelatin index of refraction
30°	28°	1.22	1.24
45°	33°	1.29	
60°	45°	1.22	

I repeated this experiment at school with a thick piece of plastic:



Here are the results:

θ_1	θ_2	calculated index of refraction	average index of refraction
30°	18°	1.61	1.60
45°	25°	1.67	
60°	34°	1.54	

Conclusions:
The beam of light bends when it goes from the air straight into the piece of plastic (or gelatin) toward the horizontal line, and away from the normal line when it goes from the piece of plastic(or gelatin) back into the air. As the angle of incidence $\theta_1$increases, the beam bends more (the angle of refraction θ_2 increases).
As shown in the pictures, my kitchen was a mess, but I enjoyed. My students also seem to like more a hands-on experiment class than a usual one.
What is your opinion?