

## Bringing Optics to High School: From Eyeglasses to Holograms

Eyeglasses have been used since at least the 13th century and we are still actually surrounded by light from the Big Bang. But the technological applications of optics and light sources have grown explosively only in the last 20 years.

After teaching junior- and senior-level college courses on optics for several years, I have seen that students growing up in the age of laser disks, supermarket checkout scanners, and fiberoptic communications have had surprisingly little exposure to what the components and principles really are behind these important technologies. Since my research is also in these areas, I felt that I should go one step earlier in the educational chain and share some of my excitement in this field with high school students. In addition, I wanted to initiate a dialog with the students on a regular basis about various topics in science and engineering to encourage them to consider a career in these areas. With these thoughts in mind I set out to make contacts with the high school a few yards from my home.

The first step was to call the principal's office. From there, I was put in touch with the science teacher, who also was the advisor to the school's science society. There was a mutual apprehension at first about the scope of my visit: my concerns about the reaction and responses of the students to my visit and subsequent talk, and the teacher's concerns about a college professor's unfamiliarity with the instructional systems in the school. To help alleviate these problems, I arranged to visit the school and talk to the teacher prior to my first presentation to the students. From that meeting and follow-up telephone conversations, I was able to understand their expectations and properly tailor my talk to the students I would meet. The teacher suggested that my talks be scheduled as a part of the visiting lecture series of the Science Society, which met weekly after school on Fridays. I kept mathematics to a minimum because the attendees at the talk included seniors, juniors, and some sophomores. The format was show and tell. I brought components such as lasers and light emitting diodes so the students could see them at close range. I made a point of arriving a few minutes early so I could mix with the students.

The first talk was on light sources, attended by about 25 students. The aim was to familiarize the students with types of light sources and to bring out their differences and similarities. I presented the topic using transparencies that I had prepared, and the students were urged to ask questions during the presentation. I brought a

He-Ne laser, a semiconductor laser diode, and a light emitting diode that I used for demonstrations throughout the talk. Some of the students asked a few questions, mostly on the general perceptions about lasers and their effects on humans. We compared the different light sources in terms of color, optical power output, and beam directionality, and also the costs. The comparison allowed the students to understand the use of different source types for specific applications.

### Optics Topics Presented to High School Students

1. Optical Sources: Lamps, Lasers and Light Emitting Diodes
2. Holography
3. Optical fibers
4. Applications of lasers in medicine
5. Bubbles in Fluids
6. A visit to the Drexel Lightwave Engineering Laboratories

After the presentation, lasting about 45 minutes, the students were encouraged to examine the sources that I had brought with me. Some used that opportunity to ask more questions about lasers and specific applications. Also, some students asked for copies of the materials I had used, so before the second presentation I gave the teacher a set of my materials to duplicate for the students.

The second talk was on holography. I brought with me several different types of holograms, such as conventional holograms (which required a He-Ne laser), white light reflection holograms, hologram pendants and a host of others.

I gave a total of five seminars at the high school. Each time, the visit was organized so that the students not only could listen, but also could experience the technology up close. After a few seminars, the students became less apprehensive and more friendly. Attendance in these seminars fluctuated between 15 and 25. In place of a sixth seminar, the teacher and five students visited the Drexel University Lightwave Engineering Laboratories. During this visit I demonstrated the operation of a laser and a fiberoptic communications link and how to splice fibers. I also asked the students about some of the topics that they wanted me to discuss, and the later seminars were geared to meet this goal.

I believe the frequency of my visits was very important to keep up the students'

enthusiasm. Frequent visits made the students feel that I was a part of their science education. Familiarity also made the students more comfortable about asking questions on any general or specific topic. Some of the students brought newspaper clippings about some new scientific discovery and asked questions about different aspects of it. My access to the equipment and components made the seminars more interesting, and allowed the students to handle the components while querying me about them. Since I was in constant contact with the science teacher, it was possible for me to tailor the presentations to suit the class. The success of my seminars was in large part a result of the teacher's enthusiasm and the constant communication between us.

I have stayed in touch with the science teacher since my visits and we have discussed another trip by high school students to my laboratory. Because the school is close to my home, I occasionally run into Science Society members and chat with them.

My school visits were highly rewarding on a personal level. It also showed me that there are many exceptional students in the high school system with the inquisitiveness and willingness to learn about cutting edge technologies. In the coming school year I look forward to bringing my presentations to one or two other high schools in my geographical area.

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The Education Exchange highlights the experiences of scientists and engineers with local schools, along with helpful hints and resources. If you would like to share your own involvement in science education, contact Finley Shapiro, Department of Electrical and Computer Engineering, Drexel University, Philadelphia, PA 19104 U.S.A.; Telephone (215) 895-6749; Fax (215) 895-1695; Email: shapiro@ece.drexel.edu

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