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Informal optics education and outreach programs in Southern California

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ABSTRACT

Over the past decade, Southern California has seen informal optics education and outreach programs grow substantially, mainly due to efforts from members of the Optical Society of Southern California (OSSC) and more recently the Optical Society of America, UC Irvine, Student Chapter. Also, the Optics Institute of Southern California (OISC) has served as a focal point for many of these programs, as an independent organization working closely with society members and other partners. This paper provides an update of these programs, including a new OSSC website that provides a new platform for significantly expanding the member participation efforts.

Keywords: Optics education, outreach programs

1. INTRODUCTION

The Optical Society of Southern California (OSSC), an OSA Local Section, was founded in 1951 and has several aims and purposes. These are: 1) to increase and disseminate the knowledge of optics and closely allied sciences, 2) to promote the mutual interest of investigators, teachers and students in these fields, and of designers, manufacturers, hobbyists, and users of optical instruments and allied scientific apparatus, and 3) to encourage cooperation and establish acquaintanceship among these persons.

The Optics Institute of Southern California (OISC) is an Orange County-based nonprofit organization dedicated to the promotion of math, science, and engineering education through the use of optics and related technologies and phenomena. Their educational approach is hands-on, student-centered, and engaging. They seek to foster the curious scientist, the artful mathematician, and the creative engineer in every student, regardless of age.

The OSA Student Chapter at the University of California at Irvine (UC Irvine) is a student organization, which promotes optics and related technologies to various groups at UC Irvine as well as different communities in Southern California. They collaborate with organizations such as the OSSC, Newport Corporation, and the UC Irvine Beckman Laser Institute and Medical Clinic. Their activities involve meetings with OSSC members and industrial leaders of Southern California, seminars and lecture series by renowned scientists in related fields. Science outreach to local elementary, junior high, and high school students is also an large part of their activities.

In this paper, we will briefly describe the approach members of these organizations have developed and implemented and then focus on presenting examples of the results they have achieved using various tools and methods. We posit that these can be effectively used as models for groups in other geographic locations to improve upon existing optics education and outreach programs.

2. STRONG LINKAGE AMONG GROUPS

For many years, since the OSSC was founded, it was the sole organization in Southern California promoting optics education outreach. In 1988, a position was created within the society to generate scholarships for deserving people in the field that participate in optics educational outreach in local schools and communities. In 2003, the OISC was founded as a project of Community Partners. It is a 501(c) 3 non-profit organization, focusing mainly on expanding the optics educational outreach programs and providing a vehicle from which OSSC members and other interested volunteers could seek grant funding.

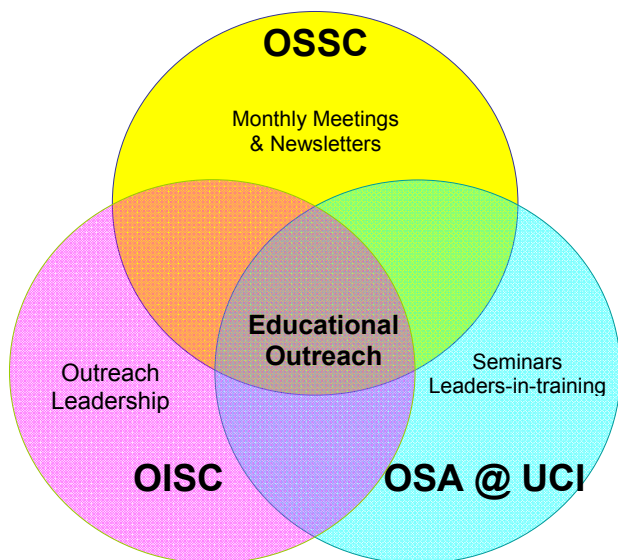


Fig. 1. Venn diagram showing relationships between optics outreach groups in Southern California

In 2005, the UC Irvine OSA Student Chapter was founded in order to merge ideas from different optics-related fields and disseminate those ideas to the larger public. In addition to having many of its own student run seminars and events, they also collaborate closely with the OISC and OSSC.

The members of these three organizations have worked together to build a strong linkage that has optics educational outreach at its core. In addition, these three groups have often assisted other groups that have had varying degrees of success in their optics education and outreach efforts. Such groups include, but have not been limited to: The Optical Society of San Diego, The Optical Society of Northern California, The IEEE Laser Electro-Optics

Society, Los Angeles Chapter (now the IEEE Photonics Society) and OSA and SPIE Student Chapters at UC Riverside, UC San Diego, Cal Tech, and UCLA. In addition, new student chapters at Cal Poly Pomona and USC will be founded during the next academic year. The OSSC has recently appointed a volunteer to coordinate student chapter formation and maintenance in Southern California to help build strong bonds between OSA student chapters and local sections.

3. THE OSSC OUTREACH COMMITTEE AND THE OISC

The establishment and operations of the OISC has enhanced the OSSC outreach efforts over the past seven years. Those operations are now being folded back into the OSSC in part due to the new OSSC website, which will be addressed in more detail in the next section. As with any growing organization, the OSSC outreach efforts are being picked up by individual volunteers in a more formal means so that more can be accomplished towards meeting the aims and goals.

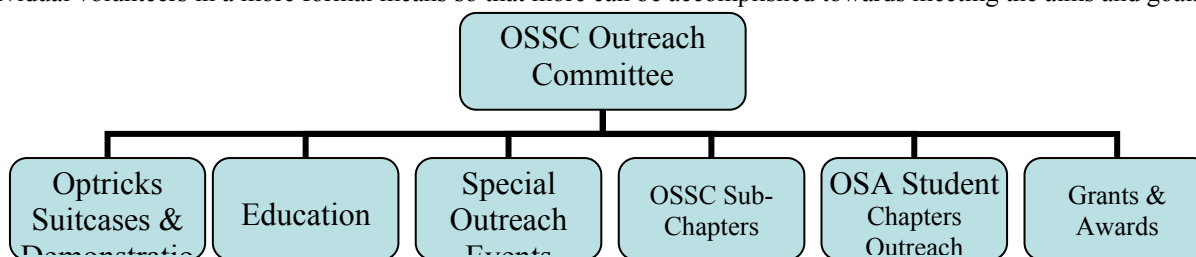


Fig. 2. Organizational chart showing the OSSC Outreach Committee structure.

The above organizational chart shows how the OSSC Outreach Committee is structured, allowing each component to be addressed by an individual or small group of volunteers. At this early phase of the transition, individuals have stepped up to take on the following sub-committees: Optricks Suitcase and Demonstrations, Education (at least in part) and OSA Student Chapter Outreach. The other sub-committees will continue to be fulfilled by the OISC while new volunteers are recruited to take on these responsibilities.

4. NEW OSSC WEBSITE FACILITATES OUTREACH

The synergistic outreach efforts of the OSSC and the OISC have been enhanced by modern web technologies. In 1999, Darcy DiNucci coined the term “Web 2.0” [1]. The term describes the evolution of the internet where applications facilitate rapid content development, sharing and networking by liberating the user from technical hurdles and providing an extremely flat learning curve. For the casual user, sites such as *FaceBook* and *Twitter* are representative of Web 2.0. The professional networking site *LinkedIn* is another example. An OSSC group on *LinkedIn* has been particularly helpful in fostering networking among our members and communicating outreach projects.

In the summer of 2009, the OSSC moved its website to the third party platform provider ClubExpress. This decision was not trivial since it increased in website expenses from \$140 per year to about \$1000 (based on 200 members). It was made after several years of experimenting with beta sites developed with the help of consultants and open source applications that were unable to meet our requirements. The Web 2.0 level support provided by ClubExpress has built into the platform numerous applications useful for club management. Online features include: membership and non-membership databases; member signup and renewal; payment processing; an event calendar and sophisticated online event registration; discussion forums; surveys suitable to handle elections; an e-commerce store front; simplified document, photo and video sharing; a news platform; donation processing; committee management; data output and reporting; email management; tracking of financial transactions; and an online membership directory. OSSC officers can decide which features to activate and which to hide. Also, OSSC members can update their contact information and control visibility of their online directory information. As ClubExpress improves its platform, the hundreds of clubs it supports are all impacted. The OSSC was able to go from a trial to a live website with ClubExpress in 45 days including the uploading of our membership records and implementing many features desired for years.

The new OSSC website has fostered outreach in several ways. First, by outsourcing technical development and facilitating organizational management the officers have more time to spend fostering outreach efforts. The membership chair now spends more time bringing new members to the organization rather than processing paper applications and managing a spreadsheet of membership records. Second, the wiki-style page editing provided by ClubExpress facilitates rapid content development and document sharing such as educational presentations. One of the first custom pages developed on the OSSC website was an outreach page heavily linked to the OISC website. The ClubExpress platform allows educational materials and documents to be easily shared, outreach activities rapidly communicated and errors quickly corrected. Third, fewer people are missing event notices because of out-of-date contact information. Fourth, simplified online application and renewal processes have allowed our membership to grow with fewer members being lost through attrition. Fifth, an online non-member database, provided for free by ClubExpress, facilitates the growth of the organization by allowing anyone visiting the OSSC website to add their name to our non-member database using a link near the top of the page. Non-members who register for events online are also added to the database. Sixth, the non-member database has grown with support from international professional societies. The Optical Society and ClubExpress recently facilitated uploading about 800 local OSA members into our non-member database. A final way the website can facilitate outreach is the ability to manage sub-organizations through the website. We have not yet implemented this available feature but are considering the option as a way to support recently formed student organizations and inactive local sections.

The new OSSC website has also streamlined outreach efforts of the OSSC. An initial hurdle to website migration was the annual expense, which is currently covered by ten website sponsors. Using an under menu feature built into the platform, these corporate sponsors, who already pay an annual fee for corporate membership, are able to pay an additional annual fee to have their company logo on every page of the OSSC website. Given the likely increase in website sponsors and the planned implementation of an online store, the website is expected to become a feasible source of revenue for the Society's outreach activities. The planned online store will also serve as a method to distribute educational and other outreach materials along with items such as clothing and coffee cups that help promote the OSSC and partner organizations.

5. VARIOUS EDUCATIONAL OUTREACH PROGRAMS IN SOUTHERN CALIFORNIA

Over the last seven years, the optics outreach efforts in Southern California have resulted in many programs and events of different size, duration, reach and composition. We have recently completed our 7th Annual Optricks Day Event at the Discovery Science Center, expanding this year to include a new Optricks and Laser Extravaganza in honor of the 50th Anniversary of the invention of the laser. The Laser Extravaganza included an on-going Hands-On Laser Graffiti demonstration run by student volunteers from the UC Irvine OSA Student Chapter and a custom Laser Science Spectacular Show put on by Prismatic Magic (sponsored by OSSC Corporate Members acknowledged at the end of this paper). Also included in this year's event were a new Hogwarts School of Optricks & Astronomy Telescope Challenge to compliment our traditional Optricks Suitcase presentations and Educational Stations. Also, our own famous Dr. Murty Mantravadi, the Wizard of Light and a long-time member of the OSSC, attended to his education station along with our many volunteers.



Fig. 3. Logos being use by optics educational outreach groups in Southern California. The left hand photo shows Dr. Murty and guests at the recent Optricks & Laser Extravaganza. See more photos on-line at the OSSC website.

The above logos have been developed and used as part of the promotional “get the word out” effort to attract volunteers and sponsors as well as attendees for the various events and programs. One example of an annual event these which groups participate is Astounding Inventions at the Irvine Valley College where the groups have been using the OSA / Girl Scouts of America *Lighten Up* “Spinning Your Color Wheels” hands-on activities and the Hogwarts School of Optricks & Astronomy Telescope Challenge.



Fig. 4. Students and volunteers have fun with “Spinning Your Color Wheels” and the Telescope Challenge during Astounding Inventions at Irvine Valley College. “Blink” the Math Monkey was a special guest.

Other outreach events have been held in conjunction with the Family Day Events at the UC Irvine Beall Center for Art + Technology. These events take place two to three times annually. This was reported at this conference previously in 2007. Schools of all levels, from primary to high school have hosted our group's optics educational outreach events in their classrooms and other larger facilities. Some of these schools include Lambert, Roosevelt, and Alden Primary Elementary Schools, Barcelona, MacArthur, and Costa Mesa Middle Schools, Santa Ana High School, Curtis School Foundation, as well as Braddock Gifted and Davis Magnet Schools. Photographs taken at these event and more are posted on the OISC, OSSC, and UC Irvine OSA Outreach websites.

Some typical outreach tools

Many different optics educational outreach tools have been borrowed from other programs and modified for use in our programs, like the Optricks Suitcase, Laser Graffiti, and *Lighten Up "Spinning Your Color Wheels"*. Other activities have been developed on an ad hoc basis; such as the Hogwarts School of Optricks & Astronomy Telescope Challenge, the Fish Bowl Optics, the Teen Optricks Bench, the Color Integrating Sphere, and many of Dr. Murty's original Optricks. This section will briefly discuss some of these activities and show selected photos of each. Again, more information about these events can be obtained through our websites.

The Optricks Suitcase

The Optricks Suitcase continues to be a foundation tool that is used by many outreach volunteers in Southern California. Originally developed by the OSA Rochester Section, it has been modified and used extensively in our programs. It continues to be used as it was originally designed in classroom settings of up to about thirty students aged 10-14. Additionally, it has been modified and used in science center theaters, for art gallery Family Day Events and home school programs. Approximately 15 of these suitcases have been donated to outreach volunteers and thousands of take home theme packets have been given to students, parents, teachers and other interested people. This tool was also reported on previously in 2007.



Fig. 5. The Optricks Suitcase including the four “take-home” theme packets are (clockwise from top): Rainbow Peephole, 3D Polarization Glasses, Magic Patch, and Magic Dots.

The Hogwarts School of Optricks & Astronomy Telescope Challenge

Several versions of this project have been developed and used at various events beginning with its first use at a summer 2007 Orange County Girl Scouts of America Harry Potter Carnival. A commercially available “Optics Harry Potter Spells and Potions Kit” was found and purchased from online and used along with other components to create the first Telescope Challenge.

Another version the Hogwarts Telescope Challenge has been used frequently at science centers and family day events as part of optics educational outreach stations. Here volunteers ask the guests to discover the differences between various ‘telescope like’ optical instruments, such as inverted and non-inverted telescopes, kaleidoscopes, periscopes and a monocular. These instruments allow the guests an opportunity to consider the optical differences.

A third version of the Hogwarts Telescope Challenge was used with telescope kits from the Hands-On Optics (HOO) project (donated by SPIE) in conjunction with an education station and SPIE posters being distributed. As seen in the photos, many of our volunteers dress up in wizard (and Harry Potter) costumes much to the delight of the young students and their parents.



Fig. 6. First use of the Harry Potter Optics kit in Southern California



Fig. 7. a) A typical use of the Telescope Challenge as an education station in Southern California.
b) More than 100 HOO telescope kits were distributed during a Los Angeles Tech Awareness Day.

The final version the Hogwarts Telescope Challenge has used PASCO Introductory Optics Bench Kits to have students experience the optics of focusing a telescope and creating an image they can see. This has been used with other more traditional telescopes, including the famous “Galileoscopes”.



Fig. 8. a) Telescope Challenge using the PASCO Optics Bench at the MacArthur Middle School Science Night event.
b) Telescope Challenge showing students the Galileoscopes and a Newtonian telescope.

Fish Bowl Optics

Another fun and successful outreach tool that was used at a Barcelona Hills Science Family Night was Fish Bowl Optics. This has been used to teach students about how the optics of the human eye function. A brief lecture with big picture diagrams is used to introduce the topic and then the students have lots of time to learn by doing (or playing). An LED object (or laptop computer screen) is used as the object and the fish bowl is placed near the screen to imitate the eyeball.



Fig. 9. a) Fish Bowl Optics helps explain how the optics of the human eye works.
b) Students experience the results of Fish Bowl Optics.

Laser Graffiti

The OSA Student Chapter at UC Irvine took up the OSA sponsored Laser Graffiti challenge and created an award winning YouTube Video (<http://www.youtube.com/watch?v=1M19vo0EYfi>) for Laser Fest, the yearlong celebration of the 50th anniversary of the Laser. Using software developed by the Graffiti Research Lab Vienna [2], they are able to reversibly draw onto buildings with light. They were able to utilize that same technology inside of the Discovery Science Center as part of our Optricks & Laser Extravaganza allowing guests to create their own Laser Graffiti images. This event is incredibly fun and offers opportunities to teach people about lasers.

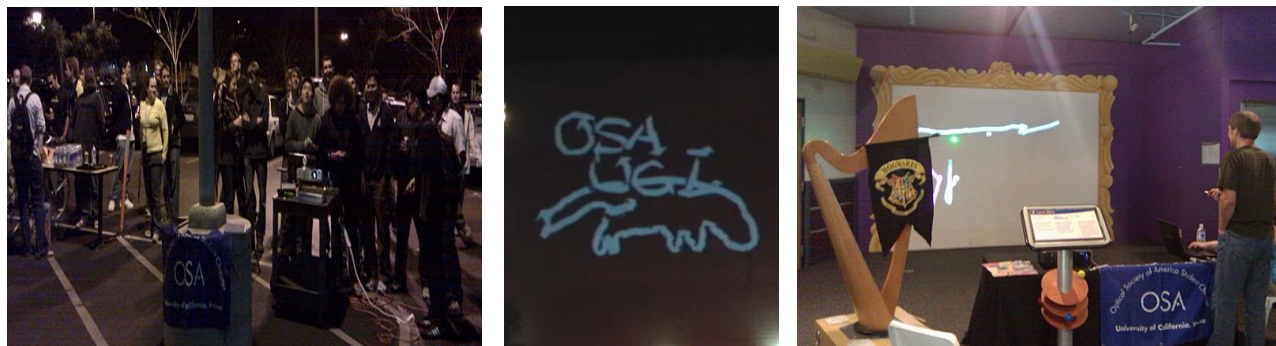


Fig. 10. a) UC Irvine OSA Students making their Laser Fest YouTube Video entry, b) One of the images created using Laser Graffiti, c) Laser Graffiti at the Discovery Science Center.

Chemistry at the Space Time Limit (CaSTL) outreach at the Discovery Science Center

A group of UC Irvine faculty, staff and students associated with the National Science Foundation (NSF) funded CaSTL project coordinated with the staff and volunteers at the DSC to provide on-going outreach education stations for the promotion of the sciences used in their research efforts. The OSA Student Chapter volunteers coordinated the optics outreach education stations, which were similar to those used during the Optricks & Laser Extravaganza event, with some assistance and materials from OSSC and OISC volunteers. This was the first time such an on-going effort was implemented over the course of many weeks and we look forward to continuing this program in the fall.

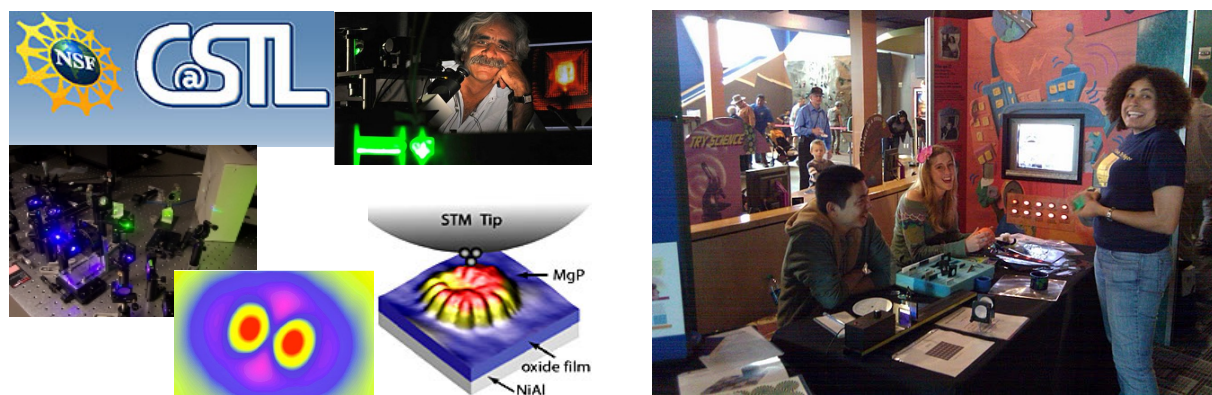


Fig. 11. a) CaSTL Outreach logo showing the principal investigator in one of his labs, along with some of the current research in that lab. b) Student volunteers at one of the CaSTL Optics Education Outreach Stations at the DSC.

6. CONCLUSIONS

Three separate but similar organizations in Southern California (the OISC, OSSC, and OSA UCI Student Chapter), have worked together closely to disseminate optics education and outreach across their respective areas. These organizations have successfully combined both existing and newly developed methods of optics education in order to effectively teach optics fundamentals to children of all ages. A newly designed website has also been constructed which greatly assists the OSSC with the aggregation of new members and the spread of information about the organization. These programs have been extremely successful in the past, and will be continued in the future.

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2. Joe Adams and the staff and volunteers at the Discovery Science Center who has hosted our now seven annual Optricks Days at the Discovery Science Center where we have reached a few thousand young people of all ages.
3. David Familia and Samantha Younghans-Haug at the UC Irvine Beall Center for Art + Technology for inviting our programs to the Family Day Events several times per year since 2006.
4. OSA and SPIE for their continued support both financially and with much encouragement.
5. The Optical Society of Southern California, without whom none of this would have happened.

8. REFERENCES

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