

Outcomes from the IYL2015 Quality Lighting Teaching Kit Program: Reaching for the Stars

Constance Walker^{1,*} and Stephen Pompea¹

¹National Optical Astronomy Observatory, 950 N Cherry Ave, Tucson, AZ 85719 USA

Abstract. Poor quality lighting not only impedes astronomy research and our right to see a starry night sky, but creates safety issues, affects human circadian sensitivities, disrupts ecosystems, and wastes billions of dollars/year in energy consumption. It also leads to excess carbon emissions. How do you change the mindset of society that is used to turning night into day? You educate the next generation on quality lighting. As an outcome of the International Year of Light 2015, the U.S. National Optical Astronomy Observatory's Education and Public Outreach group has produced a Quality Lighting Teaching (QLT) Kit. The kits are designed around problem-based learning scenarios. The kit's six activities allow students to address real lighting problems that relate to wildlife, sky glow, aging eyes, energy consumption, safety, and light trespass. The activities are optimized for 11-14 year olds, but can be expanded to younger and older. All materials are in English and Spanish. Most of the activities can be done within a few minutes during class or afterschool in the form of stations or as stand-alones. Everything one needs for the six activities is included. Tutorial videos on how to do the activities can be found at www.noao.edu/education/qltkit.php. Ninety-two kits have been distributed to 32 countries with the help of SPIE–The International Society for Optical Engineering, CIE–International Commission on Illuminations, OSA–The Optical Society, IDA–the International Dark Sky Association, and the IAU OAD–Office of Astronomy Development. Highlights from the initial program evaluation will be discussed.

1 Introduction

The International Year of Light in 2015 was an opportunity to bring awareness of light pollution issues and lighting solutions based on the principles of quality lighting to a younger generation. Under the sponsorship of IAU and the OSA Foundation, the NOAO Education and Public Outreach (EPO) group developed and tested an educational kit for ages 11–14 to be used either in classrooms or in out-of-school programs. The kit provides problem-based learning activities on six common light pollution issues. (See Figure 1 and Section 2.)

* Corresponding author: cwalker@noao.edu

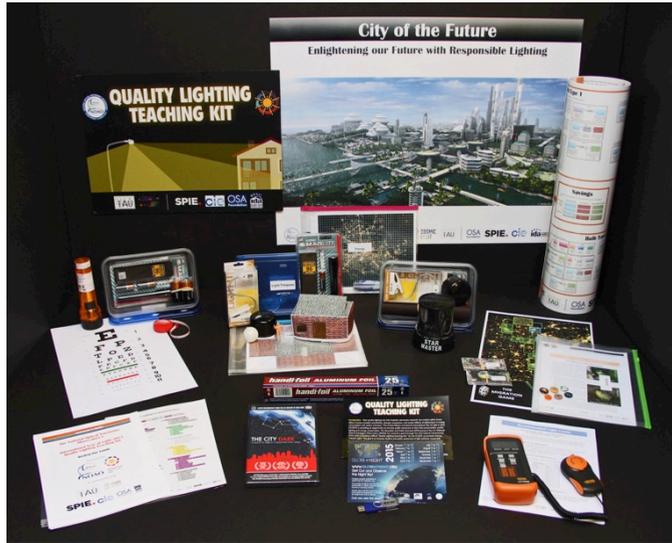


Fig. 1. The posters, activity materials and other components in the Quality Lighting Teaching Kit.
Image Credit: Pete Marenfeld, NOAO

One hundred Quality Lighting Teaching (QLT) Kits were built in late 2015. In early 2016, kits were sent to 92 stakeholders in 32 countries (including Argentina, Armenia, Chile, Colombia, Ethiopia, India, Latvia, Nigeria, Tanzania, and Zambia). The recipients were chosen by our project partners: SPIE–The International Society for Optical Engineering, CIE–International Commission on Illuminations, OSA–The Optical Society, the International Dark-Sky Association, and the IAU Office of Astronomy Development. Although the kit recipients were experts in the fields of illumination engineering, light pollution mitigation, and astronomy education, there was a better chance of the kits having optimal impact if recipients received extended training in using them. (See Section 3.)

2 Problem-based learning activities

The concepts and practices of quality lighting are explored through problem-based learning (PBL) activities, as well as formative assessment probes. The six activities use quality lighting to solve realistic cases on how light pollution affects wildlife, the night sky, our eyes, energy consumption, safety, and light trespass into buildings. The impact of the kits is amplified by providing professional development using tutorial videos created at NOAO and conducting question and answer sessions via Google+ Hangouts for program instructors. The Quality Lighting Teaching Kit program leverages NOAO EPO’s work over the last ten years in lighting and optics education (e.g., “Hands on Optics”, the International Year of Astronomy’s “Dark Skies Rangers”, the IAU “Dark Skies Africa”, and Arizona Public Services’ “Dark Skies Yuma” programs).^[1,2,3,4,5]

2.1 The setting of the PBL activities

The premise of the activities is that the instructor is the mayor of a fictitious city in which the students live (inspired by the City of the Future Poster). The mayor has been receiving complaints from citizens of the city, which all have to do with the lights in the city (stated on the Issues Poster). The students have been assembled into 6 different task forces, to

determine the underlying problems expressed in each of the 6 complaint categories, as well as to come up with feasible solutions to those problems.

2.2 The implementation of the PBL activities

The students start by reading the information presented in their group's poster. The "Now Try This!" section gives instructions for an experiment, game, or activity to complete in order to gain more understanding of the problems with which they are presented. They use the materials in their box and/or envelope to explore the activity. Using what they know along with help from the Problem Solving Poster, the students brainstorm solutions to their problem. The students then carefully consider the implications (both positive and negative) of their solutions, as well as any exceptions where their solutions may not work. They determine if there is any other information they need to better understand the problem or have better solutions. This may involve using the links provided or key ideas from the poster to research more about their problem.

3 Professional development

3.1 Tutorial videos online

The geographic extent of the project precluded providing professional development in person to lighting educators. Instead, tutorial videos on each of the six learning activities were developed in the spring of 2016. The videos were narrated by the NOAO EPO undergraduate students who had assembled the kits. The videos are posted on the project's webpage, www.noao.edu/education/qltkit.php. Each video is seven to fourteen minutes in length, concisely and clearly spelling out how to perform the activities using a problem-based learning approach.

3.2 Training via Google+ hangouts

The video-based training was augmented by 14 Google+ Hangouts (each one hour long) that provided additional Internet video-based discussion of the activities. The Hangouts allowed the kit recipients to interact directly with the kit creators and expert guests, who were happy to field questions. A viewer could text questions to the host and live guests. For the convenience of the viewers, two Google+ Hangouts were done per topic, one for the Australian/Asian side of the world and one for the African/European side of the world. People in the Americas could attend either.

3.3 Facilitator responses

Reactions from kit recipients who have utilized the tutorial videos have been extremely positive. (See Figure 2.) Peter Offor, scientific officer at NASRDA – Centre for Basic Space Science in Nsukka, Nigeria, said, "The video tutorials added flesh to the whole activities ... going through the videos, I could appreciate each activity better." He added that "the Hangouts I participated in gave me courage to go out and teach our younger generation what I have learnt." Other participants felt that the Hangouts helped create an engaged community of teachers using the kits. The SPIE student chapter from the Universidad Nacional de Tucumán in Argentina organized a meeting before the Hangouts began in which they watched the tutorial videos and performed the activities. They felt that the videos made everything quicker and easier to learn. This student outreach group also

translated 10 of the 11 posters included in the kit into Argentinian Spanish and performed the activities in classrooms. All the materials, including the posters and tutorial videos, have been translated into Chilean Spanish as well.



Fig. 2. Students of Ejiofor International College, Nigeria during QLT Kit program activities

The Internet video-based workshops have been an excellent method for reaching the many project partners around the world. Even though alternative ways were created to train people on activities at a distance, traditional workshops are still conducted when possible. The emphasis has been on regions of astro-tourism at sites surrounding observatories such as the island of La Palma in the Canary Islands, Yerkes Observatory, Kitt Peak National Observatory, and Cerro Tololo Inter-American Observatory. (See Figure 3.)



Fig. 3. Workshop in the Canary Islands on the Quality Lighting Teaching Kit at the Starlight, Beyond Light Pollution workshop attended by astro-photographers, local teachers, astronomers and staff from the La Palma Office of Tourism. Image Credit: Valentin Grigore, SARM

4 Conclusion

The funding from OSA Foundation, IAU, and NOAO made the creation of the Quality Lighting Teaching Kit possible. The partnerships with OSA, SPIE, CIE, IDA and the IAU OAD facilitated effective kit distribution. The QLT Kit program is the fourth program developed by NOAO Education and Public Outreach to address light pollution. From the responses to the vast testing of the kit in 2015 and after, the kit has been wildly successful in its popularity and effectiveness and is appropriate for use by a wide variety of audiences and ages. The program is becoming a legacy of IYL2015. With the help of commercial and/or foundation funding, we plan to build additional kits for the global community. Like the changes in cultural perceptions and actions on smoking and littering, we hope to bring more awareness on how quality lighting locally can redress light pollution issues globally.

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