Astronomy Outreach for Inner City Youth (YOPAstr)

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Overview

The ongoing outreach and education partnership between Carthage College and the Appalachian Mountain Club (AMC) has, over the last four years, reached over 25,000 members of the public while training undergraduate science students and full-time and seasonal AMC nature education staff in astronomy and nature outreach, and science communication. This very successful program motivated us to develop tools and activities to engage teachers who work with under-served youth – an audience we had not previously addressed. Support from the OAD was obtained so that this audience could be provided in-depth training for science education based on astronomy.

Programs

Two workshops were held in a train-the-trainer format, as this provides the best reach to the most students, and the best long-term impact. The primary goals of the training process were:

1. Provide real, hands-on experiential learning activities that teachers and other educators could take back to their respective educational organizations and institutions and implement with students of varying ages, from roughly 5 (first grade) through 18 (high school/college).
2. Provide science content and information that links the activities to understanding of the big-picture, single system nature of the Universe, linking astronomy content to the full suite of natural phenomena. This is important as it overcomes the conventional implementations that put different topics into independent 'silos', without linking/structuring the information and understanding, and also allows a teacher to tailor his/her presentation to address any earth/physical/life science area.

Participants

The first workshop was held for forty-five (45) teachers organized through the Youth Opportunities Program of the AMC, as part of their outdoor leadership training activities. This was fortuitous, as it brought together a large group of teachers in a dedicated training environment, in a venue in which we could link the astronomy content to the nature education they were receiving. As each of these teachers engages with 30-90 students each academic year, the immediate reach of this training is at least 2000 inner city students (using a round-average of 50 per

instructor-year), though that number will obviously grow with time. Also addressed during this workshop were the YOP instructors – AMC permanent and seasonal staff who work with inner city teacher groups throughout the year and support their efforts to bring nature and outdoors education to students who do not otherwise have access to such content. Thus, this activity provided train-the-train-the-trainer (two levels) content that will reach additional teachers in the future….who will then reach even more young students.

The second workshop was held for fifteen rural teachers coordinated with North Country Education Services, which provides support to schools and districts with substantial populations of underserved students. This cohort allowed us to reach a group of teachers that addresses another body of students who do not have access to solid science education content, and where education resources are extremely limited. Each of these teachers reaches 15 to 50 students each year; the cohort therefore addresses between 250 and 750 students annually.

These two groups allowed us to span different types of students and academic environments where science (especially) astronomy content may not be available. Their scale permits the effort to ultimately address thousands of underserved students.

Activities

The workshops contained a number of activities that were hands-on and easily incorporated into classroom and workshop/experiential environments. Four different activities were utilized for these teachers.

1. Earth/Moon system: This activity was performed for both groups. An inflatable model earth and a softball, representing the moon, were set out, and the teachers had to set them at the appropriate scaled distance for the actual Earth-Moon system. This activity can be performed with any two approximate-spheres, with a ratio of roughly 4:1 in diameter, and appropriate scaled distances (to show this, it was also demonstrated with an onion and a garlic clove!). Key to this activity is not only the apparent emptiness of space between objects, but the following core science content: (a) angular scales, as the moon's apparent size, when viewed from the model earth, is the same as its apparent size in the sky (30 arcmin), a novel approach to understanding angular dimensions; (b) the 'oddness' of Earth have a large (relative to its size) satellite, atypical for rocky planets; (c) the implications of having a large satellite, including tides and tidal pools, as well as effects on ocean currents. This last area is critical, as it brings in biological impacts (viz. tidal pools being critical to the evolutionary transition of life from oceans to land) and environmental effects (global climate). Thus, teachers take away from this a very simple demonstration that can be

extended to address a wide range of astronomy, mathematics, earth science, and life science topics.

2. Scale of the Solar System: In this activity teachers are introduced to a variety of on-line and app-based astronomy products that can be used to get information about astronomical objects, in this case emphasizing the solar system. Our program concentrates on using SkySafari (on tablets and phones, though we also use it on laptops). The activity, in this implementation, utilizes a ping pong ball as a scale model of the Sun (painted a mottled orangy-yellow….for effect). The cohort is broken into nine groups, each given a solar system object (the Sun and eight planets). The Sun group must measure the physical model and determine the effective scale (using SkySafari to get appropriate dimensions); each other group is then required to use that scale and SkySafari data to determine the effective scaled distance of each object from the Sun, and its scaled diameter. Participants then build a scale model of the solar system, placing cards with each planet's name at the appropriate distance (note: 100 foot tapes were available so that measurements could be made). Each group then presents a short talk on key features of each planet. The activity thus provides participants with experience in doing scaling, basic arithmetic operations, astronomy content on solar system objects, presentation and communication of science content to audiences, and team building. The activity can be conducted with any roughly spherical object as the Sun, giving the project leader options as to the final size of the model. With a ping pong ball, Neptune is about 150 m away….using, for example, an M&M candy for the Sun the model becomes a somewhat more manageable 45 m. Also, the teachers were instructed on different ways to engage students with the necessary data, ranging from web searches, use of the SEDS 9 Planets Tour site, various apps available for phone, tablet, or desktop, and basic sources such as encyclopedias and dictionaries. This activity has, in the past, been executed with youngsters (ages 8-10) up through adults and seniors, and is very effective at bringing distance scales and solar system content to diverse audiences.
3. Dark Skies Preservation: This demonstration utilizes a bright flashlight (e.g., a Maglight), a cap of some sort (we use a 1.5 inch PVC pipe cap) and a small figurine. With the lens and shield removed from the Maglight, a simulated unshielded streetlight is created, with the figurine placed below it. Audiences cannot see the figurine because of the veiling glare produced by the 'street light'. When the cap is placed over the light the figurine 'magically' appears, demonstrating the value of fully shielding lights. The Maglight utilized in this demonstration is a dual-level light source; the demonstration is repeated with the lamp dimmed to half brightness. The audience sees that the ground lighting is more than sufficient when the shield is utilized, thus demonstrating that light fixtures, if properly shielded, can utilize lower wattage lamps, reducing energy usage. Discussion of the effects of light pollution (veiling glare, cancer rates, shadows and safety, effects on

migratory birds and animals, etc.) follow the demonstration. Presentation was made of various online and application-based tools for studying light pollution, as well as citizen science activities such as GlobeatNight. This activity is very valuable for teachers, as it engages students with their local lighting environment, and provides an outlet for connecting students with data acquisition and the potential to create improvements in night time lighting.

4. Galileoscope: The Galileoscope project was originally launched for the 2009 IYA, and has continued to supply kits for science education and outreach since then, including serving as a cornerstone for the 2015 IYL. The teachers who operate in inner city and poor rural environments generally do not have the resources to obtain good science demonstration equipment, such as Galileoscopes. Therefore, we supplied Galileoscope kits to each of the NCES teachers, and led them through a detailed assembly activity, teaching optics principles as well as the historical development of telescopes. These kits were designed to be repeatedly assembled and disassembled, thus they will be useful in the classrooms to which these teachers return. The free availability of detailed lesson plans, activity guides, instructions, etc. on the project website make them particularly useful for teachers to engage their students, even in areas where there is little physical access to science professionals.

Outcomes/Evaluation

We utilized our standard program evaluation form (see Appendix for the actual document), distributed to all participants. All of the data are useful, but we are most interested in the responses to questions 5 and 6, which measure attitudinal shifts and personal motivations. In the programs conducted for the YOP teachers and the NCES teachers, more than 85% responded that they were motivated to 'learn more' and to 'attend more astronomy programs' to a Great Extent; all responses were either Great Extent or Some Extent. Thus, the attitudinal data indicate that the programs were successful in engaging the participants and moving them forward in connecting their students with astronomy content. All responses to question 7 showed that the program was 'Very Useful and Interesting', indicating that the content was of the right character and presented at the right level.

These data are archived and incorporated into the overall assessment and evaluation effort of our outreach program. It is important to have had the opportunity, with OAD funding, to directly target these teachers who reach underserved populations.

Future Efforts

All of the participating teachers would like to utilize the activities from this program in their education efforts. Several of the activities require little in the way of resources; though it is helpful to have the 'best' (such as SkySafari), there are other means to implement these activities and bring the necessary information and content to students.

This is not the case with Galilescopes, which the teachers find one of the very best tools to engage students as it leaves them with a permanent tool to engage them with the sky (one of the original goals of the Galileoscope program). Finding suitable funding sources to provide them with Galileoscope kits will continue to be a challenge, and a limiting factor in the ability of teachers to do this kind of hands-on activity with their students.

As the YOP program is an ongoing and major AMC program, we will be doing continued follow up with those teachers, and disseminating the workshop content to other YOP teachers who could not attend (over 900 teachers have been certified through YOP). One of the benefits of the workshop that was conducted was that AMC training staff were also participating, and can bring this content to a broader YOP audience. Continued follow up with those staff will be beneficial to reinforce the material and ensure further dissemination.

Other AMC education programs, such as A Mountain Classroom (AMCR) could also benefit from these kinds of workshops, and we hope to be able to do so in the future.

Astronomy Program Evaluation Form

1.What was the topic of the talk? _____

2. What is your age?
◯ Under 17 ◯ 17-25 ◯ 26-39 ◯ 40-59 ◯ 60+

3. What is your gender? ◯ M ◯ F

4. What is the highest level of your education?
◯ High school ◯ College ◯ Graduate school

5. To what extent did this talk motivate you to learn more about the topic?
◯ Great extent ◯ Some extent ◯ Not very much

6. To what extent did this talk motivate you to attend other astronomy programs?
◯ Great extent ◯ Some extent ◯ Not very much

7. Did the talk provide useful and interesting information?
◯ Very useful and interesting
◯ Only somewhat useful and interesting
◯ Not really

8. How did you hear about this program? Check all that apply:
◯ Dinner talk ◯ Word of mouth ◯ Signage
◯ Previous programs ◯ Other: _____

Please provide any comments you have to help improve these talks.

_____
_____
_____

If you would like more information from us, please leave us your email address:

_____

Thank you!