Fostering Undergraduate Biology Students’ Engagement in Active Community Education

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Abstract
Whether exploring a newly discovered rainforest, the ocean floor, or a novel signaling pathway, scientists exemplify exploration of the unknown. Recently, Saint Leo University has restructured the undergraduate Biology degree program to create a focused approach to inspire future scientists. The changes included creating three different concentrations, biomedical, ecology, and general biology. Six core values are emphasized in the programs including excellence, personal development, community, respect, integrity, and responsible stewardship. To foster greater interactions between undergraduates and younger students within and around the community, the Biology program engages in outreach programs. The programs focus on using engaging, hands-on approaches including design science, data analysis, manipulative models and vibrant discussions. Most recently, Biology majors have participated in outreach with a 1st grade class, hosting a DNA day for the local community, and the HOPES funded Students Participating in Active Community Education program in a high school AP Biology classroom. The impact of these efforts on increasing interest in STEM and creating stronger ties with the community was assessed in the high school program. Pre- and post-tests were administered to measure knowledge gains as a result of the interactions. 46% of students demonstrated gains in understanding. Moreover, 100% of the students indicated that they felt more confident about the material covered. The majority of students also demonstrated improved comprehension of related class assignments. The programs have proven to be influencing the future of science education by inspiring students not only at the college level but also at the pre-college level too.

Background
- There is predicted to be an upcoming shortage in STEM professionals, so there is a desire to get more pre-college students interested in STEM disciplines, through exposure to outreach activities.
- Service learning is one way this is achieved while also allowing undergraduate biology students to experience “interdisciplinarity” in their education, thus preparing them to be well-rounded scientists.
  - Content Areas:
    - Central Dogma of Molecular Biology
    - DNA Structure/Function
    - Properties of Water
    - Bonds/Molecular Interactions
    - Gram positive and negative bacteria
  - Active Learning:
    - Water kits for kinesthetic modeling of bonds and properties of water
    - DNA and proteins models with structural features of the molecule, bonding, and molecular components

Events:
- DNA Day - Saint Leo students and faculty lead local community members through DNA structure and function discoveries
- Saint Leo Community Day - Students and faculty taught children from the local community about water, bonds, and DNA
- Warton High School Outreach - Students taught high school AP Biology students about protein structure and function
- Observing the Solar Eclipse Community Outreach - Saint Leo faculty and students taught community members about the sun, sun safety and solar eclipses and provided protective eyewear for safe viewing of a partial solar eclipse
- Hillier Academy Outreach - Saint Leo students engaged elementary school children in the scientific method

Figure 1. DNA Day and Saint Leo Community Service Day.
Saint Leo students and faculty taught local community members the Central Dogma through the use of models of DNA, proteins, and water. Visitors to the campus were able to take home their own models of DNA, keychains, and bracelets shaped like DNA, and were even able to isolate their own DNA from cheek cells and store it in a keepsake necklace.

Figure 2. Warton High School Outreach.
Undergraduate students taught high school AP Biology students about protein structure and the Central Dogma of Molecular Biology through the protein story of PLA, a protein of Yersinia pestis, the bacterium that caused the Bubonic plague. Students built PLA from the primary structure to the quaternary structure. This was a 2013 ASBMB HOPES Seed Grant funded effort.

Figure 3. Observing the Solar Eclipse Community Outreach.
Saint Leo faculty and students taught community members about the sun, sun safety, and solar eclipses. While adults were treated to a lecture on the myths and legends surrounding eclipses, children made sundials and models of the layers of the sun and also made bracelets with UV-sensitive beads. At sunset, protective eyewear was provided for safe viewing of the partial solar eclipse.

Conclusions
- An examination of pre- and post-assessments in the high school outreach demonstrated that of the 22 students who completed both assessments, 13 (59%) improved on the overall score on the post-assessment, which an average score change of 11% (3.25%), paired two-tailed T-test)
- Students demonstrated gains in understanding on 16 (46%) of questions on the post-assessment
- 100% of the students indicated that they felt more confident about the material covered.
- 100% of students indicated that they had a better understanding of the level of protein structures
- 89% of students indicated that they had a better understanding of how mutations impact protein structure and function

What’s Next
- Saint Leo University will be performing an outreach program with Saint Anthony Catholic School on the week of April 13th
- Undergraduate students will develop active learning activities based on the 7th and 8th graders level of knowledge.
- A pre-test will be given in order to measure where the outreach needs to focus on. After the outreach has been completed, the students will take the same test in order to measure the changes in comprehension.
- Saint Leo University will also be holding a celebration of the International Year of Light on April 9th. The community will be welcomed to learn about transformation through the use of the pGLO-gene in bacteria and zebrasfish.

References

Student and Community Feedback
- “This is better than MOSSI (Museum of Science and Industry)”
- “We enjoyed the presentations and the atmosphere of inquiring minds. Thank you for opening such events to the community.”
- “The DNA models were a smashing success as were all the hands-on activities.”
- “The kids loved it! It was an amazing lesson and so interesting.”
- “I liked the college questions that the students answered at the end.
- “It served as a pretty good review of protein structures”

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