Engaging undergraduates and community college students in research

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For the past five years, the Indiana Space Grant Consortium has been funding my laboratory's project which aims to engage undergraduate students in real research projects, beyond the classical classroom lab experience. The vison of the project is to provide a meaningful research experience to students, develop their laboratory skills, increase their academic performances to improve STEM retention, and eventually create a new workforce for NASA related research.

Background: In the gut, fluid secretion (aka gut clearance) represents one defense mechanism against commensal pathogens. The Na^+-K^+-$2Cl^-$ cotransporter 1 (NKCC1) is a potent regulator of fluid secretion, and protein kinase C down-regulates fluid secretion by causing NKCC1 internalization (1). The large intestine is colonized by both bacteria and fungi. *Candida albicans* (*C. albicans*), a commensal fungus, can shift its morphology from spore to filamentous and invade the human body (2). Interestingly reports have shown that space flight (*i.e.,* microgravity) decreases the human body defense and increases bacterial and fungal virulence (3, 4).

Research project My research aims at *(i)* understanding the regulation of colonic fluid secretion by NKCC1, and *(ii)* defining environmental cues responsible for the morphological change of *C. albicans* in the gut. Our working hypothesis is that upon exposure to environmental cues, *C. albicans* shifts its morphology from spore to filamentous, lowering fluid secretion by altering NKCC1 expression and invades the human body. Using a colonic cell model (T84 cells), students are studying the regulation of NKCC1 during protein kinase C activation. Using biochemical approaches, they are determining the fate of NKCC1 after internalization. As shown in picture 1, Amanda Bazaldua (a community college student) is using an immunoassay to quantify the level of NKCC1 in T84 cells after activation of protein kinase C. In collaboration with Dr. Michael Watters at Valparaiso University, we are investigating environmental cues (*e.g.*, microgravity, estrogen level) on the morphological shift of *C. albicans* from spore to filamentous. Toward this end, students inoculate plates or liquid media with *C. albicans* as shown in picture 2 (Idalia Zachara, first generation college student) and use bright field microscopy to identify morphological shift in experimental condition versus control. Students are engaged in all steps of

the research, as shown in picture 3, Paige Camp and Idalia Zachara are working together to analyze results and design new experimental procedures. Over the past five years, students have attended and presented seven posters at the Indiana Academy of Science annual meetings. They also have presented their work at Valparaiso University during Biology colloquiums and annual research symposiums.

Other outcomes: A total of twenty-two students have been engaged in the projects, seven of them were indirectly impacted, while fifteen received hourly salary for work in the lab. Five students started research at freshman level and have stayed in my lab for their four years at Valpo. Importantly, the project has allowed me to recruit students from different minority groups (Asian, Afro-American, Hispanic, Indian) and underrepresented groups (sixteen Females in STEM, five first generation college student, five community college students) and has contributed to create a more diverse and inclusive work environment.

References

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