AAI Education Committee Highlight: Teaching Tools

In 2016, the AAI Education Committee initiated a new session focused on improving immunology education: the Immunology Teaching Interest Group (ITIG). The ITIG is an informal group comprised of past speakers and attendees of the ITIG sessions at the AAI annual meeting, including current immunology educators spanning a range of institutions and levels. It serves as a resource for novel teaching tools and practices that can be implemented in courses to enhance immunology education. The annual sessions have grown from an audience of 20 in 2016 to more than 100 participants in 2019 (the last time the session was held in person due to the cancellation of IMMUNOLOGY2020™ and the virtual format of IMMUNOLOGY2021™). Because of the great interest in this topic, the AAI Newsletter *features "Teaching Tools" articles highlighting ITIG strategies and presentations.*

Using Remote Access Technology for Pandemic and Post-Pandemic Teaching of Flow Cytometry Analysis

Timothy J. Wilson (AAI '14),
Assistant Professor, Miami University, Oxford, Ohio

The SARS-CoV-2 pandemic has required many course adaptations for remote learning. While some of these adaptations will be discarded when classes return to an in-person setting, others may be retained for their own pedagogic value.

The immunology course at Miami University is an elective for upper-level undergraduates and early master's and doctoral students. Students may take the lecture only or include the lab, which is offered as a one-credit, two-hour-per-week option. In the lab, students engage in an integrated series of hands-on exercises designed to illustrate the adaptive immune response using immunological techniques. This series typically comprises: the preparation of an alum-adjuvanted "vaccine" and immunization of mice; blood serum collection at two weeks post-immunization and after the boost for antibody characterization; mouse dissection to identify lymphoid tissues; and preparing and staining splenocytes for flow cytometry analysis. Interspersed within these integrated labs are other exercises to reinforce concepts covered by the lecture course.

With the return to campus for the Fall 2020 semester disrupted by the pandemic and classroom occupancy limited, significant adaptations to the course structure were necessary. For example, exercises based on microscopy and histology were instead taught online using stock images of cells and tissues. While this was adequate for illustrating basic concepts, students were not able to navigate the image fields under microscopy to observe the cell and tissue morphology. Other exercises had similar experiential limitations and their impact on long-term recall remains unclear.

There was one adaptation for remote instruction that improved the topic mastery as demonstrated by students on written reports. As a substitute for in-class, TA-assisted flow cytometry analysis, students were given an intensive, remotely performed flow cytometry data analysis assignment. The university has one workstation within its core instrumentation facility with the FlowJo license dongle, allowing access for only a single contemporaneous user. In typical years, students would need to work as individuals or small groups around this workstation, often with limited time and with a TA present.

For remote teaching, in-person access to the flow cytometry analysis workstation for students was not possible, and access to the computer was instead provided through the university VPN and remote desktop software NoMachine. Students were provided with FCS files from existing research experiments and asked to remotely use the FlowJo workstation to identify and enumerate different leukocyte populations in mouse splenocytes. They analyzed five fluorescent parameters for the markers CD19, CD3, CD11b, NK1.1, and the viability indicator Zombie Aqua. They were also asked to discriminate doublets using forward scatter and prepare a layout showing the identification of the major leukocyte populations in spleen.

This setting turned out to be advantageous since the remote nature of the lab required students to complete the assignment individually and provided a more intensive exposure to flow cytometry data. Not only did they need to have a basic understanding of the data, but they were responsible for generating the plots and gates on their own.

All students were ultimately able to complete the exercise and nearly all demonstrated competency with data layouts they submitted for grading. This system for remotely accessing the analysis workstation, while still allowing only one user at a time, expanded software access for the students, and I anticipate maintaining this remote-access capability going forward.