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, 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 session has 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™). Because of the great interest in this topic, the AAI Newsletter *features "Teaching Tools" articles highlighting ITIG presentations.*

Putting Movement into Immunology Active Learning

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We all know that movement is good for immune function. Here, I argue that movement can also be good for *learning about* the immune system. Below, I outline two examples from a recent paper that involve movement-based activities in immunology instruction.[1] I have used these in an elective undergraduate lecture course with 20 to 25 students; the same principles could be adapted to almost any level of immunology teaching.

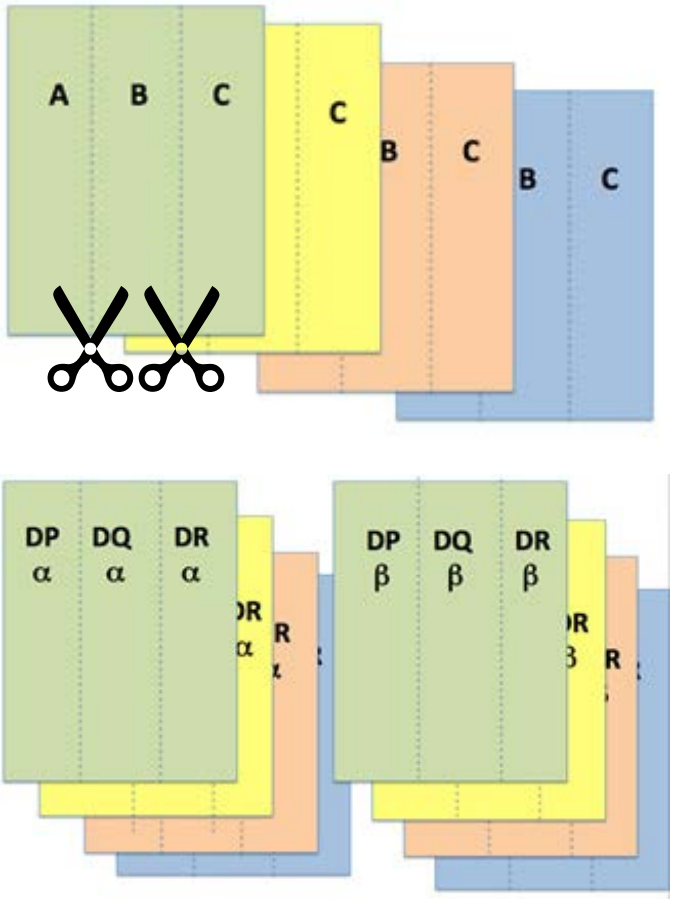
By definition, active learning employs a student-centered approach, where students are *doing things* and *thinking about* what they are doing, rather than passively receiving information.[2] When teamwork and movement are involved, active learning also takes on a kinesthetic element. I have found these movement-based activites can lead to unforgetable "aha" moments for some students. To be effective, the activities require preparation before class (student and instructor) plus a willingness to be creative and spontaneous. As a benefit, students engage in higher order tasks, like application of new knowledge and synthesis of information. Finally, we know from research that active learning helps to close achievement gaps, increase retention, and improve comprehension for all students, and especially for those from traditionally marginalized groups.[3,4]

Major Histocompatibility Complex (MHC) diversity exercise

The mechanisms that regulate MHC diversity and its role in immune function are notoriously difficult concepts to master. They employ core principles like polygeny, polymorphism, and codominant expression, often taught in prerequisite courses, and thus have the potential to facilitate connected learning.

Before this activity, we cover the nuts and bolts of MHC locus and protein structure. This usually involves a prior lecture, some reading, and a short set of preclass questions that students answer online. This exercise employs packets of labeled colored paper (representing polymorphism) to simulate MHC genes.

Students work in pairs to recreate the genomic organization of their MHC genotype. I circulate to answer questions and check work. Once all have recreated genomic arrangements, students hold up their paper genes, illustrating the phenotypic diversity in the room. This leads to excellent discussions of homo/heterozygocity, codominant expression, allotypes, and individual- *versus* population-level diversity. This part of the activity takes approximately 30 minutes. Time allowing, students may create "paper gametes," mate with another student group, and generate a new MHC genotype, designed so that unique class II allotypes appear.



Labeled pieces of colored paper simulate MHC genes for the MHC diversity exercise. Different colors represent polymorphisms.

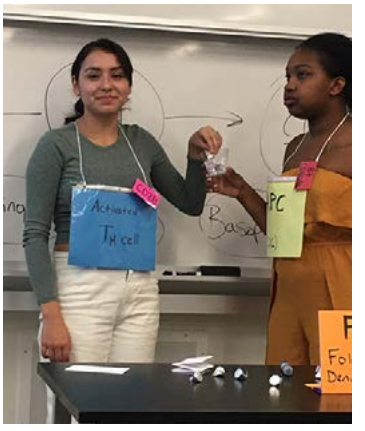
Students work in pairs to recreate their MHC genotype during the MHC diversity exercise.

We then discuss mate selection and the association between specific alleles and disease susceptibility or resistance (this can take upwards of 20 minutes). While I was able to adapt this activity to online learning using slides, it lacked the visual power of standing in a room with a rainbow of MHC allotypes on display!

Acting out an immune response

Each time I teach immunology, we spend time acting out specific immune processes. Before doing this, we cover the mechanics of antigen processing, MHC presention, plus B and T cell activation. However, I find that putting these ideas together into a sequence is challenging for most students. This activity asks students to practice "walking through" an element of the immune response.

The students' favorite reenactment comes during the B cell affinity maturation segment of the course and is fondly referred to as the "candy relay race." Hershey's kisses make nice antigens, students serve as volunteers for various cell types (wearing placards), labeled pins substitute for surface markers and co-modulatory molecules, and bubbles make a nice simulation of cytokine release. While only five to eight students are needed as volunteers, the audience can also be engaged as stage directors who tell student volunteers what they should do next. The entire process takes a chunk of time (at least 50 minutes) but leads to great clarifying questions and enlightening discussions, plus lots of candy eating and laughter.



Top Image: Students act out B cell affinity maturation during a "candy relay race."

Bottom Image: Students reenact the process of T cell activation.

Conclusions

Much like movement aids lymphatic circulation, students' movement around the classroom can help to surface clogged conceptual learning. I described two examples applied to undergraduate immunology. Of note, I found that virtual instruction presented both challenges and opportunities to incorporate these and other active learning exercises into my teaching. I am certain there are many other examples of active learning in immunology teaching. I look forward to hearing of others' experiences and having more opportunities to share these teaching strategies.

References

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