

## **Online simulations to support the teaching of physiology wet lab practicals**

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The endocrine regulation of male reproductive function is a key component of undergraduate Physiology learning at Monash University. The teaching of this theoretical content is traditionally supported by a wet lab practical that involves students physically dissecting male rats to (1) identify normal reproductive structures, such as the testis, epididymis, vas deferens, prostate and seminal vesicles, and (2), to observe and measure their function using assays such as organ weight, sperm motility and seminiferous tubule diameter. This activity is followed by a second practical class where students apply this knowledge and dissect male reproductive organs from rats with altered reproductive function (such as castration or vasectomy, or hormonal treatment such as testosterone or estradiol). With rapidly increasing class sizes (140 in 2010; 388 in 2016), these practical class activities have become increasingly challenging to teach effectively, present a growing burden on resources, and ethical issues due to the growing number of animals required and some student's aversion to handling animals in practical classes. To overcome these problems, we designed and developed an online simulation, or virtual experiment, that allowed us to reduce the number of animals, while increasing the number of treatments and experimental conditions that students could experience.

This on-line simulation was created to support the theoretical knowledge as well as to allow students to experience the experimental components in an interactive learning space. Following the implementation of the simulation, we conducted an evidence-based assessment of the effectiveness of this computer-based teaching method using a student survey (Monash University Human Ethics Approval: CF16/1441-2016000778). Overall, students showed high levels of engagement and 92% reported that the simulation helped them learn the concepts of male reproductive endocrinology. The findings showed that there was no clear preference for physical dissection over the simulation, but 80% of students reported that their combined and complementary use best supported the concepts being taught. The students also appreciated the efforts of staff to reduce the number of animals used in this practical activity and the ethical issues involved in working with animals.

Overall, the successful development and implementation of this on-line simulation has demonstrated the effectiveness of a computer simulation to convey key concepts in Physiology-based learning. The approach to convey wet lab principles, findings and data interpretation without relying on traditional physical dissections of animals provides several benefits to both students and physiology educators. While this study was specific to male reproduction, the results also support the use of computer simulations like ours as a teaching method that facilitates student engagement, assists learning, and provides an effective alternative to animal dissection.