

Developing online STEM lab courses

Online education has come a long way. The days of online courses that mirrored self-paced correspondence courses of old are thankfully behind us. Quality, instructor-led online courses regularly feature rich student-student and student-instructor interaction, hands-on active learning and engaging media content. However, STEM lab courses have been seen as particularly challenging to develop for online delivery. Can students effectively complete sophisticated laboratory exercises and then demonstrate their understanding of complex hands-on concepts and activities in an online setting?

Furthermore, even if STEM labs could succeed online, why would one want to abandon traditional labs and lecture halls and explore online modalities? In this first of a four-part series addressing online STEM labs, we're going to address this "why" question.

Over six years ago UAF eLearning worked with Dr. Richard Collins, Professor of Atmospheric Science, to develop ATM 101X: *Weather and Climate of Alaska* as an online lab course. Dr. Collins sought to offer students across Alaska access to his content expertise, expand the exposure of his program, and enable students to perform science research within their local contexts. He also sought to offer science education to those students who could not otherwise take advantage of traditional place and time limited educational opportunities.

Students in ATM 101X receive a laboratory kit enabling them to conduct their own atmospheric and weather observations. They demonstrate their attainment of learning objectives through discussions with their peers, with Dr. Collins, and by creating and sharing video presentations of their work.

Since the first offering of ATM 101X in spring of 2012, more than 200 students from across Alaska have conducted hands-on science research, collected data, and connected with their peers and Dr. Collins to explore atmospheric phenomena around Alaska and the world.

Another established example of an online lab course from UAF is Professor Abel Bult-Ito's BIOL 043/194/394 *Massive Online Research Experience (MORE)* classes in behavioral neuroscience research. Similar to Dr. Collins's goals, Dr. Bult-Ito sought to provide access to his unique research opportunity at scale and to break down traditional barriers

of time and place, allowing students who would otherwise not have access to his expertise to perform and participate in cutting edge animal research and to support his teaching mission.

Since their initial offering in the fall of 2015, more than 100 students have completed Dr. Bult-Ito's MORE online behavioral neuroscience courses. In these entirely online experiences, students receive animal research training, explore background literature and then collect observational data. Students independently observe recorded mouse behaviors under different experimental conditions, including under treatments that the students design themselves. Students analyze their own (BIOL 394) or the class data (BIOL 043, BIOL 194) and provide interpretations of the data for discussion with their peers and Dr. Bult-Ito.

Both ATM 101X and BIOL 043/194/394 provide access to unique, high quality, lab-based, rich science education experiences for students across Alaska and the world, overcoming traditional educational limitations of time and place.

Lastly, other institutions are pursuing similar endeavors to take advantage of new capacities to engage students, express their presence in STEM education, and dissolve these same barriers. A quick Google search reveals many of our peer institutions with growing catalogs of online STEM lab courses and related program offerings reaching out locally and globally.

[Colorado State University](#)
[Oregon State eCampus](#)
[PennState World Campus](#)

FURTHER READING

Falconer, E. K. , Griffith, J. C., Wood, B. L., Archaryya, S., Roberts, D. L.. 2018, A comparison of online and traditional chemistry lecture and lab., *Chemistry Education Research and Practice*, 19, 392-397.

Rowe, R. J. , Koban, L. , Davidoff, A. J. , Thompson, K. H., 2017, Efficacy of on-line laboratory science courses. *Journal of Formative Design in Learning*, 1, 1-12.