# Taxonomy of online lab solutions

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Last week we explored a few reasons for developing an online STEM lab course: to meet student demand, to reduce barriers of time and place for students, to expand the scope of one's own research, to reach new audiences, and to engage students in scientific inquiry within their local contexts.

Online lab activities can be split into four main categories. Recent iTeach+ collaborations with faculty from American Public University and City University of New York further highlight these areas. Watch the video recording at UAF MediaSpace.

## VIRTUAL LABS AND SIMULATIONS

Many modern face-to-face lab courses include significant computer-based or scaled simulation/model components where safety, cost, and convenience prohibit hands-on activities. Computer simulations adapt easily to the online realm. Virtual labs, such as those offered by Labster.com, are growing in popularity due to their low cost and convenience of access. Both of these solutions are commonly considered to yield inferior learning outcomes when compared to hands-on labs where physical manipulatives are practical.

## REMOTE ACCESS LABS

In Remote Access Labs students control physical scientific equipment and collect data from physical phenomena over the internet. Design and setup costs can be significant and often implement a combination of real-time video and web-based controls. At UAF, Dr. Ken Severin, Director Emeritus of the Advanced Instrumentation Laboratory, developed and teaches GEOS 600 *Introduction to X-ray Spectrometry* as an online course. The two main lab instruments,the JEOL scanning electron microprobe, and the X-ray Fluorescence instrument, have the capability to be run remotely.

Online remote lab portals are increasingly common at campuses across the United States and the globe including these remote online labs from the University of Munich in Germany.

## KITCHEN LABS

Kitchen Labs feature hands-on activities using commonly available household or "kitchen" components. Students are responsible for acquiring lab materials independently. This low cost option is easy on administrative overhead. However, some students may have challenges obtaining some materials and the limitation to commonly available materials can be a barrier to some learning objectives.

## LAB KITS

Commercial lab kits are a popular solution. For about the cost of a textbook ($100 - $200), commercially prepared, customizable kits ensure every student has access to the same components. A vendor solution effectively outsources the burden of acquisition and delivery of lab materials. In addition, many commercial kits are offered with free online support and curriculum materials which integrate with Blackboard and other LMSs. Two popular vendors are eScience Labs and Hands-On Labs. The former boasts they already work with over 400 institutions nationwide.

Instructors can also create their own lab kits. This solution offers greater control of kit contents for activities and the attainment of learning outcomes, but at the cost of significant administrative overhead. Dr. Richard Collins, Professor of Atmospheric Science at the Geophysical Institute, puts together kits for his ATM 101X: *Weather and Climate of Alaska* students, and Dr. Mingchu Zhang, Professor of Soil Science/Agronomy will be exploring kit strategies for NRM 380 *Soils & Environment* this fall. Here's a brief compilation of excerpted online lab instructions that UAF eLearning has been working on with Dr. Zhang.

When making design decisions for your online labs, return to and refocus on your intended objectives before tackling the question of how to get there. Dr. Collins states, "The online version of ATM101 is not just a distance version of the F2F class. We kept the exams the same, but worked through all the laboratory components to create investigations that emphasized the following (i) understanding based on experience (ii) observing locally and connecting globally. Also, the focus moved away from lecturing and toward more discussion of work done by the students." It is important to note that while Dr. Collins retained his original learning objectives, he was careful to reconsider the best path to attain those same objectives. This is a critical approach for successful online lab design.



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