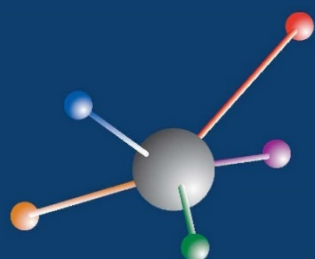


North American Network of Science Labs Online

Project Summary

September 2018



NANSLO

NORTH AMERICAN NETWORK
OF SCIENCE LABS ONLINE

REAL DATA • REAL EQUIPMENT • REAL PEOPLE



REMOTE LABS - EXPANDING ACCESS TO STEM
FOR HIGHER EDUCATION STUDENTS

www.wiche.edu/nanslo

*NANSLO's Experiences in Deploying a
Web-based Science Laboratory*



NANSLO
NORTH AMERICAN NETWORK
OF SCIENCE LABS ONLINE



Western Interstate Commission
for Higher Education

The North American Network of Science Labs Online (NANSLO), with WICHE as its hub, was an international consortium of online science laboratories operated by accredited community colleges in Colorado, Montana, and British Columbia between 2011 and 2016 that successfully provided access to over 2,000 students during that time.

NANSLO – Vision, Value, Validation . . .



<https://youtu.be/znvQhNI2vMY>

Why NANSLO . . .

Institution needed to:

- Expand laboratory capacity with limited capital dollars.
- Find space quickly when there was none – students needed laboratory access now for new programs/certificates!
- Extend reach in science courses to ever increasing distance learning students.
- Provide high quality lab experiences for online science courses.
- Address missed opportunities to stimulate an interest in STEM.
- Reduce and reuse face-to-face laboratory space that often sat idle.

Student needed to:

- Access laboratories using flexible scheduling times – evenings/weekends.
- Sign up for laboratories that were not available based on their demographics (military – overseas, rural – can't get to it, underserved populations – don't have it)
- Enroll in science courses not otherwise available.
- Participate in a lab environment rich in experience while building skills transferable to the workplace.
- Reduce time and save money.

NANSLO . . .

- Provided students located anywhere in the world with access to science laboratories via the Internet;
- Leveraged the knowledge of multiple science professors to write and quickly deploy quality “learning through reflection on doing” lab activities (28 lab activities in biology, chemistry, and physics and a Survey of Biology Lab Manual and a Survey of Chemistry Lab Manual each containing 10 lab activities) designed for use in online laboratories (see list of lab activities);
- Provided high-end scientific equipment to students and delivered a real-world experience sometimes not even available in traditional laboratories;
- Provided a method of sharing equipment and lab activities across the network to all NANSLO laboratories to reduce bottlenecks experienced and/or offer students access to lab activities not available at their college, e.g. Montana students connected to the Colorado laboratory;
- Expanded access to STEM courses to underserved and rural student populations, e.g. rural Alaska students accessed the laboratory miles away from their homes and military students enrolled in Alaska and deployed to the Middle East completed lab activities; and
- Optimized the use of grant dollars.

Institutions and faculty . . .

- Identified needed lab activities for science courses and worked with NANSLO in their development;
- Selected NANSLO lab activities to be assigned to students;
- Reserved blocks of time for students to perform assigned NANSLO lab activities using NANSLO's Network Scheduling System;
- Provided students with information to create an appointment for assigned lab activities; and
- Reviewed reports on appointments made and lab activities completed.

Students . . .

- Created appointments to perform NANSLO lab activities during blocks of time reserved;
- Connected to the Internet using a computer at appointment times;
- Accessed the laboratory and equipment using a customized web-enabled control panel designed for the assigned lab activity that contained buttons, dials, visual panes, download capabilities, and teleconferencing instructions;
- Controlled robotics connected to high quality scientific equipment using that equipment just as they would in a face-to-face laboratory;
- Shared control of equipment among team members;
- Viewed the equipment as it worked through the camera presets;
- Generated and captured real time data while collaboratively discussing results as they occurred using teleconferencing;
- Downloaded high resolution images projected in the control panel display window for reports;
- Experimented with different settings while brainstorming the impact of those changes;
- Actively engaged with team members as all saw the same visuals streamed through the NANSLO viewing window and through the picture-in-picture capability;
- Used the scientific process by interpreting, predicting, classifying, modeling, and drawing conclusions from what they saw and the data collected; and
- Communicated with lab technicians to resolve technical issues.

"The experience was more than satisfying and we [the student and her lab partners] were extremely pleased to be able to do this remote lab activity." NANSLO Student

See this microscope tutorial to see how the control panel worked –

<https://youtu.be/9J526PxtKLg>

NANSLO lab activities . . .

NANSLO LAB MANUALS FOR SURVEY COURSES



[NANSLO Survey of Biology Lab Manual](https://www.skillscommons.org/handle/taaccct/7346) - Includes 10 NANSLO Lab Activities
<https://www.skillscommons.org/handle/taaccct/7346>



[NANSLO Survey of Chemistry Lab Manual](https://www.skillscommons.org/handle/taaccct/7347) - Includes 10 NANSLO Lab Activities
<https://www.skillscommons.org/handle/taaccct/7347>



Use this list to view more information about each lab activity and to access a Word document for that activity that can be saved for your use or modification.

NANSLO LAB ACTIVITIES - BIOLOGY/ALLIED HEALTH

Buffer Systems https://www.skillscommons.org/handle/taaccct/5485	Histology – Muscle Tissue https://www.skillscommons.org/handle/taaccct/5704
Cell Type Comparison https://www.skillscommons.org/handle/taaccct/5700	Histology – Neuronal Tissue https://www.skillscommons.org/handle/taaccct/5672
Cell Types Prokaryote, Protista & Fungi https://www.skillscommons.org/handle/taaccct/5685	Introduction to Microscopy https://www.skillscommons.org/handle/taaccct/5697
Diseased Cell Comparison https://www.skillscommons.org/handle/taaccct/5488	Membrane Diffusion https://www.skillscommons.org/handle/taaccct/5679
Enzyme Activity https://www.skillscommons.org/handle/taaccct/5678	Membrane Osmosis https://www.skillscommons.org/handle/taaccct/5683
Hematology https://www.skillscommons.org/handle/taaccct/5670	Mitosis & Meiosis https://www.skillscommons.org/handle/taaccct/5698
Histology – Connective Tissue https://www.skillscommons.org/handle/taaccct/5671	Parasitology https://www.skillscommons.org/handle/taaccct/5674
Histology – Epithelial Tissue https://www.skillscommons.org/handle/taaccct/5673	Photosynthesis https://www.skillscommons.org/handle/taaccct/5684

NANSLO LAB ACTIVITIES - CHEMISTRY/ALLIED HEALTH

Acid Base Titration https://www.skillscommons.org/handle/taaccct/5675	Colligative Properties – Freezing Point Depression https://www.skillscommons.org/handle/taaccct/5694
Beer-Lambert Law https://www.skillscommons.org/handle/taaccct/5691	Electron Charge/Mass (Helmholtz Coil) https://www.skillscommons.org/handle/taaccct/5676
Beer-Lambert Law – Food Dye Concentration in Sports Drinks https://www.skillscommons.org/handle/taaccct/5690	Emission Spectroscopy https://www.skillscommons.org/handle/taaccct/5696
Citric Acid in Popular Drinks – Titration https://www.skillscommons.org/handle/taaccct/5693	Gas Chromatography https://www.skillscommons.org/handle/taaccct/5677

NANSLO LAB ACTIVITIES - PHYSICS/ALLIED HEALTH

Accelerated Motion https://www.skillscommons.org/handle/taaccct/5486	Conservation of Momentum & Energy https://www.skillscommons.org/handle/taaccct/5695
Charge to Mass for Physics https://www.skillscommons.org/handle/taaccct/5692	Uniform Motion https://www.skillscommons.org/handle/taaccct/5699

NANSLO Lab Equipment Video Tutorials . . .

RWSL MICROSCOPE CONTROL PANEL VIDEO

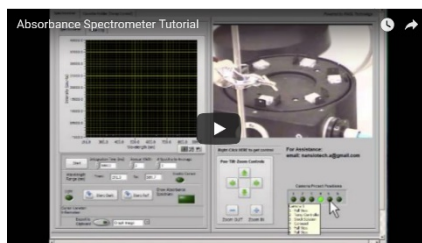


<https://youtu.be/9J526PxtKLg>

NANSLO LAB ACTIVITIES USING THE MICROSCOPE

Cell Type Comparison	Histology – Muscle Tissue
Cell Type Prokaryote, Protista & Fungi	Histology – Neuronal Tissue
Diseased Cell	Introduction to Microscopy
Hematology	Membrane Osmosis
Histology – Connective Tissue	Mitosis & Meiosis
Histology – Epithelial Tissue	Parasitology

RWSL SPECTROPHOTOMETER CONTROL PANEL VIDEO



https://youtu.be/JbDnOf_5BJQ

NANSLO LAB ACTIVITY USING THIS SPECTROMETER SETUP (ABSORPTION SPECTROSCOPY)

Beer Lambert Law	Enzyme Activity
Beer Lambert Law - Food Dye Concentration in Sports Drinks	Membrane Diffusion

RWSL HELMHOLTZ COIL CONTROL PANEL VIDEO



<https://youtu.be/PbEGDhMdZ0Y>

NANSLO LAB ACTIVITY USING THIS HELMHOLTZ COIL SETUP

Electron Charge/Mass (Chemistry)	Electron Charge/Mass (Physics)
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RWSL SPECTROPHOTOMETER CONTROL PANEL VIDEO

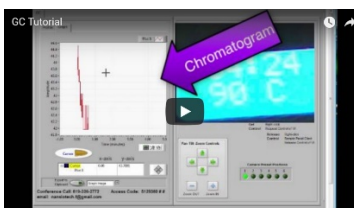


<https://youtu.be/-oQaND6ISxk>

NANSLO LAB ACTIVITY USING THIS SPECTROMETER SETUP (EMISSION SPECTROSCOPY)

Emission Spectroscopy

RWSL GAS CHROMATOGRAPH CONTROL PANEL VIDEO

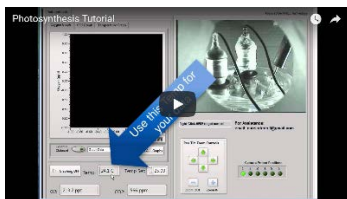


<https://youtu.be/iAMIRoME1gg>

NANSLO LAB ACTIVITY USING THIS GAS CHROMATOGRAPH

Gas Chromatography

RWSL PHOTOSYNTHESIS APPARATUS CONTROL PANEL VIDEO



<https://youtu.be/1PISiv0ueQI>

NANSLO LAB ACTIVITY USING THIS PHOTOSYNTHESIS APPARATUS

Photosynthesis

RWSL TITRATION APPARATUS CONTROL PANEL

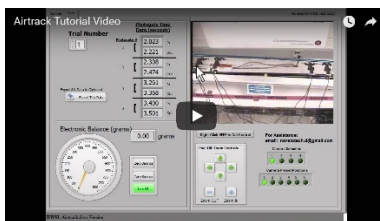


<https://youtu.be/X5V5MZcl-Vw>

NANSLO LAB USING THIS TITRATION APPARATUS

Acid Base Titration	Colligative Properties Freezing Point Depression
Citric Acid in Popular Drinks	

RWSL AIR TRACK CONTROL PANEL RWSL AIR TRACK CONTROL PANEL



<https://youtu.be/EekX1Zyo3F0>

NANSLO LAB USING THIS AIR TRACK

Accelerated Motion	Conservation of Motion
Charge to Mass for Physics	Uniform Motion

ALL Lab Activities and Lab Videos:



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Funded by a grant from the [U.S. Department of Labor's Trade Adjustment Assistance Community College and Career Training \(TAACCCT\)](#) grant.

NANSLO Value to Institutions . . .

- Addressed need to deliver a quality laboratory experience to current online students without investing in infrastructure – space, equipment, faculty/lab technicians;
- Reduced need to build more laboratories for expanding online student populations as NANSLO online laboratories were capable of serving more students than traditional laboratories, easily configuring lab equipment for assigned lab activities, expanding capacity quickly when needed, and improving efficiencies by using one lab for multiple science disciplines versus face-to-face laboratory space dedicated to just one science discipline.

NANSLO Value to Students . . .

- Built learning and innovation skills by . . .
 - Using scientific method;
 - Communicating with team and using data to create lab reports;
 - Collaborating with team members to share ideas and thoughts;
 - Sharing control panel with each other; and
 - Creatively problem solving, reflecting on activity and expected and actual results, and sharing hypothesis.
- Used information, media, and technology skills by . . .
 - Accessing data and information remotely and evaluating it;
 - Learning to remotely control scientific equipment with computer interfaces;
 - Generating and downloading data generated and high-quality images; and
 - Analyzing and drawing conclusions from real information collected in real time.
- Gained life and career skills by . . .
 - Using an Internet delivered method for completing lab activities that was flexible and adaptable to the student's needs;
 - Performing lab activities with limited direction from faculty;
 - Interacting with lab partners with diverse backgrounds;
 - Managing the lab time without supervision and completing the lab assignment with limited faculty interaction.

NANSLO Network Scheduling System . . .

Developed by WICHE and critical to efficient automated operation of a connected network offering access to multiple institutions, serving large numbers of students, and sharing of laboratory equipment across the member laboratories.

- Faculty reserved blocks of time for assigned lab activities and ran reports on student participation in the assigned lab activities.
- Students set up an appointment during reserved blocks of time.
- Institutions input information to authorize faculty to access NANSLO and run usage reports to assist in determining the effectiveness of using NANSLO from both a faculty and student perspective.
- NANSLO laboratories received notification of booked times, experiments to be run, students signed up for lab activities, without the need to manually determine when and which equipment to use for student lab assignments and ran efficiency reports to demonstrate the value of the services provided.
- Allowed sharing of resources among NANSLO member Nodes and offered a centralized system for processing of payables and receivables.
- Automatically reviewed parameters for blocks of time requested – NANSLO lab activity, date, number of students, and team size – to verify equipment and parameters available.
- Defined number of sessions needed for number of students to be served and displayed laboratory availability.
- Booked blocks of time selected and automatically sent booked information to appropriate NANSLO Node and faculty.
- Generated unique URL and PIN number for each booked lab activity and associated each to a course, section ID, and faculty.
- Recorded student reservation and associated it to the unique URL/PIN number (date/time chosen to perform lab activity within selected block.)
- Provided custom dashboards with capabilities based on role (Institutions, Faculty, and Students.)
- Provided student activity reports for faculty and institutions.
- Provided financial transaction capabilities to bill for NANSLO laboratory services.

NANSLO Laboratory Scheduling System . . .

Integrated with the NANSLO Network Scheduling System that delivered laboratory level functionality to automate its operations.

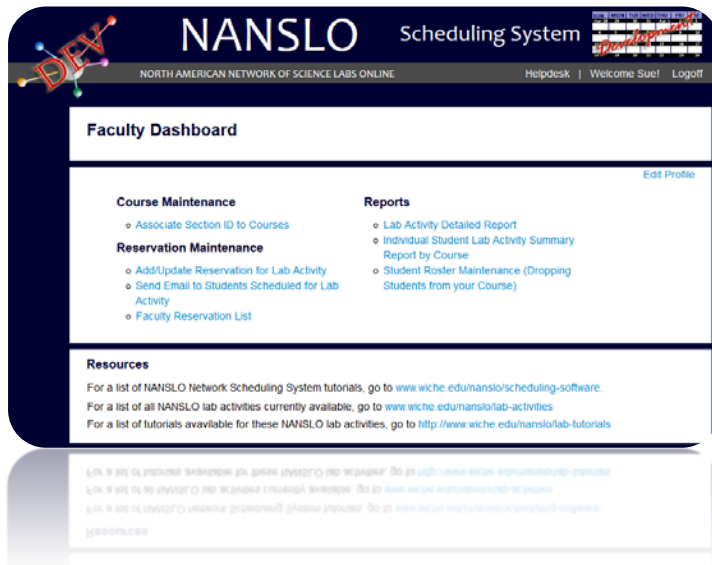
- Authenticated students on their selected appointment date and time.
- Presented the appropriate NANSLO Remote Web-based Science Lab (RWSL) control panel.
- Placed students on a specific lab station computer.
- Provided an input area for lab technicians to append comments to individual records or to all student records on a team.
- Captured attempted, logged in, and logged out times and sent data to NANSLO Network Scheduling System for reporting purposes.
- Provided other tools used at the laboratory level for delivering NANSLO services.
- Sent student data back to the NANSLO Network Scheduling System on a nightly basis for faculty and institution reporting out purposes.

NANSLO Network Scheduling System Inputs . . .

INSTITUTION ADMINISTRATOR AND/OR FACULTY INPUTS:



- Entered institution information including Scheduling System Institution Administrator and how charges would be assessed, e.g. hourly, per student, per lab activity, etc.
- Entered term and courses, section numbers, and faculty associated to courses.
- Entered information for new lab activities available for existing installed Node equipment.



- Booked NANSLO Node by selecting NANSLO lab activity, number of students assigned to the lab activity, the number of students per team, and time/date block needed (first come first serve basis).

- Provided students with a unique URL and PIN number generated by the system for a booked lab activity assigned to his/her students.

- Reviewed reports for validation of completion by students.

- Processed bills for NANSLO

laboratory usage electronically received through system and process receivable/payable records.

NANSLO LABORATORY ADMINISTRATOR:

- Entered equipment information.
- Entered secondary equipment information, e.g. slides.
- Entered lab station information.
- Entered hours of operation.
- Entered dates/times when closed, e.g. holidays.
- Entered NANSLO staff information.

NANSLO NETWORK SCHEDULING SYSTEM ADMINISTRATOR:

- Entered System Administrator information.
- Entered Member Institution Information.
- Entered NANSLO Laboratory Information

NANSLO funding sources . . .

- Original funding for NANSLO's formation came from a Next Generation Learning Challenge (NGLC) grant (2010-2011.)
- Further expansion of NANSLO through a U.S. Department of Labor's Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant (2012-2016).

NANSLO closure . . .

Although NANSLO was an exciting, viable option for institutions, instructors, and students (and still is!), moving from a free-grant-funded service to a fee-driven service proved challenging in the timeline available. As a result, lack of further funding resulted in NANSLO closing its laboratories. However, many resources, including NANSLO lab activities and NANSLO videos available through Skills Commons repository and knowledge on how to establish a web-based science laboratory and lessons learned available through WICHE contacts, are accessible to you.

Setting up a Web-Based Science Laboratory . . .

VIABILITY:

- Determine what courses and experiments make sense for an online laboratory (assists in determining equipment needs).
- Determine profile of students accessing lab (assists in determining hours of operation and feasibility of reducing bottlenecks in existing physical laboratories).
- Number of students to be served (assists in determining resources needed to serve students).
- How lab resource costs will be paid for (per class, per student lab fee needed to keep lab open and financially supported) – financial support critical for continued viability.
- Determine steps needed to get instructor buy in and training needed to prepare them for effectively using online lab (insures utilization metrics are met).
- Will the majority of instructors embrace the delivery method?

PREPARATION:

- Determine physical location of lab and space needed based on viability analysis.
- Determine appropriate high bandwidth connection – typically stand-alone connection vs. college connection to avoid potential data breach.
- Design lab configuration to maximize space and efficiency.
- Determine and purchase lab equipment including robotics, scientific equipment, lab material, e.g. biology slides needed, furniture, lighting.

- Determine lab resources needed to set up laboratory and hire them.
- Determine needed lab resources to run lab and hire them, e.g. PhDs, science students, lab technicians, etc.
- Determine how students will schedule a lab, e.g. scheduling system, sign-up sheet, etc.
- Set up timeline for installation, completion, and opening lab for students.
- Develop communication strategy and begin marketing capability and timeline for opening to instructors.
- Hold focus groups with instructors and students to determine any needs not identified earlier and to generate interest and buy in, when needed.
- Determine first semester to launch online laboratory and determine what is needed for successful launch.

ADDITIONAL RESOURCE IDENTIFICATION:

- Review existing educational material to see if it fits your needs:
 - Survey of Biology Lab Manual and Survey of Chemistry Lab Manual for general science requirements
 - NANSLO lab activities for biology, chemistry, and physics classes
- Create lab activities needed that are not available already.
- Determine if the existing NANSLO Network Scheduling System would work for you and if it could be deployed at your institution or is an in-house system going to be used or some other scheduling method.

OPENING AND CONTINUING OPERATIONS:

- Set up “checkup” sessions between instructors and lab staff to address any issues identified after start up.
- Hold periodic “checkup” sessions between lab staff and administration to address any issues identified after start up.
- Lab staff creates utilization and efficiency reports to generate and provide to administration for continued financial support.
- Lab staff develops training materials for lab.
- Performed maintenance, as needed, to maintain quality delivery.
- Lab staff develops any instructional material helpful for students and instructors to further enhance online lab experience.

- Periodically assess lab needs, e.g. expansion of equipment, space, staff, based on utilization.
- Determine any additional resources and/or experiments based on feedback from instructors and students.
- Determine what scheduling system reporting resources are needed to assist instructors in determining student participation in assigned lab activities and laboratory usage over time.

NANSLO LESSONS LEARNED . . .

- Free is not sustainable – financial support and understanding of value is a must.
- Assess your faculty – ready (supportive), reluctant (provide guidance and support), rebellious (resist and try to recruit others to reject – don't force them – students will suffer).
- Faculty sometimes require basic technology training to not only support the use of an online laboratory but assist their students in using it.
- Technical assistance must be immediately available to students.
- Technical issues must be addressed immediately to maintain confidence.
- Control panels must be easy to use and intuitive.
- Instructional videos are great but don't expect students to use them.
- Lab activities must be easy to follow and provide sufficient instruction to address anticipated procedural questions.
- Laboratory demonstrations to administration and faculty must be flawless.
- Faculty should practice lab activities before assigning them to students.
- Success takes time – not an overnight win.
- There is only value in creating connections and collaboration among online laboratories if they are willing participants.
- A centralized scheduling system connected to individual laboratory's local scheduling systems can optimize resources across a network including sharing resources when equipment is not available or an individual laboratory is booked to capacity.
- A scheduling system is a must to serve high-volume student usage whether connected across a network or dedicated to a single laboratory.

- A third party not directly affiliated with the online laboratories is helpful in facilitating exchanges among them if an association like NANSLO is formed.
- Delivery via iPhones and smart phones must be considered to reach more students.

WANT MORE INFORMATION . . .

During 2012 through 2015, WICHE delivered three professional development workshops for faculty and three for career coaches and eight webinars for faculty and eight for career coaches. Some of these were videotaped. A list of presentation materials and video presentations can be found on the Skills Common Repository at <https://www.skillscommons.org/handle/taaccct/811/discover?query=Western+Interstate+Commission+for+Higher+Education> (screens 1-4).

The list of lab activities and lab manuals with brief descriptions can also be found on the Skills Common Repository at <https://www.skillscommons.org/handle/taaccct/47/discover?query=Western+Interstate+Commission>

Additional questions can be sent to Kay Hulstrom, Manager, Institution Services, Western Interstate Commission for Higher Education, 3035 Center Green Drive, Suite 200, Boulder, CO 80301-2204, khulstrom@wiche.edu, 303-541-0294