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Chemistry Collection Overview

Engage students with hands-on experiments and lessons

Lt is a cloud-based learning platform that allows you to run chemistry labs without headaches.

The Lt Chemistry Collection includes 19 labs that encourage students to investigate general chemistry concepts through real-time data collection.

These labs address key concepts in the general chemistry undergraduate curriculum and are supplemented with Instructor's Material, saving you from reinventing the wheel and supporting you in lab preparation. The Lt grading interface further saves you time with many autograded question types, allowing you to focus on more rigorously assessing student comprehension and application.

Designed with Core Competencies in Mind

Media-rich labs in the Lt Chemistry Collection encourage active learning, and incorporate recommendations from the American Chemical Society's *Assessment Tool for Chemistry**. Co-developed with Vernier, the labs encourage scientific literacy by asking students to collect and analyse data, and draw evidence-supported conclusions.

Assessment questions have been created in accordance with Bloom's taxonomy to ensure diverse and rigorous assessment, and students are exposed to real-world applications of chemical concepts to enhance motivation. All labs include a lab report page, where students are supported to communicate their experiment in an accepted scientific format.

*Please note that the Lt Chemistry Collection is not endorsed by, or affiliated with, the American Chemical Society in any way.

- Improved efficiency
- Improved results in theory and clinical practice
- Increased student engagement
- Increased student pass rates

Developed in partnership with

Vernier

For nearly forty years, Vernier has created award-winning technology, software, and data-analysis tools for education. Their products are trusted by universities and colleges around the world. Whether you are introducing your students to enzymes or exploring primary productivity, Vernier technology is the right fit for your laboratory.

"The customisation of the labs is much appreciated as we can align the lab's background information with our lecture content and more."

- **Professor Priyanka Pant,**
  Science Department Chair,
  Lake Washington Institute of Technology, USA

ADINSTRUMENTS

Supporting Students at Varying Skill Levels

As with all labs in Lt, content can be easily adapted to meet your course requirements. A number of the chemistry labs include extension activities that expand on their core topics. These extensions increase academic rigor, but can be easily removed to accommodate courses such as those for non-majors, or where lab time is limited.

Whether fully online or on campus, Lt has you prepared for uncertainty. Students can complete labs remotely, using our built-in example data, or in the lab environment, using Vernier's suite of Go Direct® sensors to record chemical phenomena in real time.

Lt is a fully customisable lab solution that allows you to:

- Provide students with labs out-of-the-box
- Edit premade content to suit your curriculum and align with your course vocabulary
- Quickly supplement labs or create new ones from your existing content resources
- Restrict lab access to specific periods of time and grant extensions as needed
- Modify assessment questions and point values to match your academic expectations
- Track student progress using course analytics and grading features

Chemistry Collection

19 MODULE COLLECTION
Modules may include: Lab + Extension

Please note that 17 of the 19 labs have been developed for use with Vernier hardware. To use the hardware with Lt, you will need to download the kuraCloud Desktop Application from the ADInstruments website. For distance learning purposes, hardware will not be required. Each lab has a "Distance Learning" version which students can use to analyse pre-recorded example data. Please reference the Example Data brochure for more information.

Acid–Base Titration

Use a Go Direct® pH sensor to titrate hydrochloric acid (HCl) with a standard sodium hydroxide (NaOH) solution. Determine the equivalence point and calculate the unknown concentration of the analyte (HCl). Perform additional titrations using acids and bases of varying strengths to differentiate the shapes of all four titration curves, and learn about the appropriate selection of acid–base indicators.

Beer's Law

Use a Go Direct® Gas Pressure Sensor to investigate the pressure–volume relationship of a confined gas to confirm Boyle's law by comparing the pressure of air samples collected at several different volumes. In the extension activity, confirm Charles' law by comparing temperature and volume data from air placed in a series of water baths at constant pressure.

Conductimetric Titration and Gravimetric Determination of a Precipitate

Monitor conductivity using a Go Direct® Conductivity Probe while adding sulfuric acid (H_2SO_4) to barium hydroxide ($Ba(OH)_2$), and determine the equivalence point of the reaction. From this information, find the concentration of the $Ba(OH)_2$ solution. In addition, capture the precipitate and measure its mass to confirm the molar concentration of the $Ba(OH)_2$ solution. In the extension activity, explore the concepts of lattice enthalpy, hydration enthalpy, and solubility.

Determining a Chemical Formula

● *No sensor required*

Use the law of definite proportions to find the empirical formula for a hydrated compound containing copper, chlorine, and water molecules locked in the crystal structure of the solid compound. Heat a sample of the compound to drive off the water of hydration, then conduct a chemical reaction with the dried sample to produce elemental copper. Measure the mass of copper that forms to determine the moles of copper and chlorine in the sample, and thus establish the proper empirical formula for the compound.

Determining an Equilibrium Constant

Use a Go Direct® SpectroVis® Plus Spectrophotometer to analyse standard solutions of iron (III) thiocyanate complex ($FeSCN^{2+}$) and construct a standard curve. Use this curve to determine the concentration of the $FeSCN^{2+}$ complex in a series of new solutions. Accurately evaluate the equilibrium concentrations of each species in, and calculate the K_{eq} of the reaction for, each solution.

Determining the K_{sp} of Calcium Hydroxide

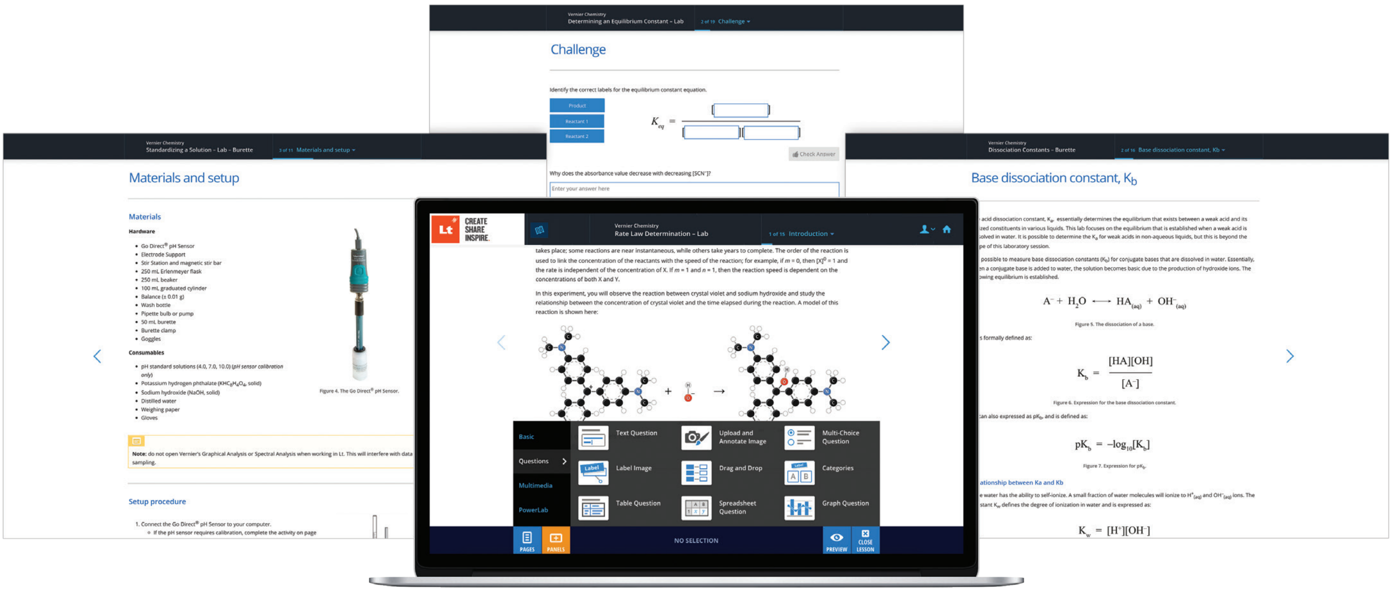
Titrate a saturated solution of calcium hydroxide ($Ca(OH)_2$) with a standard hydrochloric acid (HCl) solution to calculate the K_{sp} of the compound by determining the equivalence point. In the extension activity, add a calcium chloride ($CaCl_2$) solution to a saturated $Ca(OH)_2$ solution to learn about the common-ion effect.

Dissociation Constants

Use a Go Direct® pH Sensor to determine the acid dissociation constant, K_a, for acetic acid, using solutions of different initial concentrations. Use the K_a to calculate the base dissociation constant, K_b, before using this K_b value to calculate the pH of a sodium acetate solution and compare this pH value to an experimental value. In the extension activity, use pH data from two buffer solutions containing acetic acid and sodium acetate to observe the changes in pH caused by the addition of a strong acid and a strong base to these solutions.

Electrochemistry: Voltaic Cells

Prepare a variety of semi-microscale voltaic cells in a 24-well test plate and measure their potential with a Go Direct® Voltage Probe. Determine the potential of a voltaic cell with copper and lead electrodes. Test two voltaic cells with unknown metal electrodes and identify the unknown metals by examining the cell potentials. Observe how a voltaic cell can maintain a spontaneous redox reaction with identical copper metal electrodes, but different electrolyte concentrations. Measure the potential of a second



concentration cell and use the Nernst equation to calculate the solubility product constant, K_{sp}, for lead iodide.

Evaporation and Intermolecular Attractions

Use a Go Direct® Temperature Probe to measure the temperature changes caused by the evaporation of several liquids. Relate these temperature changes to the strength of the intermolecular forces of attraction present, and use these results to predict the temperature changes for several other liquids. In the extension activity, examine how dispersion forces are influenced by the shapes of isomers.

Identifying an Unknown Diprotic Acid

Titrate an unknown diprotic acid with a sodium hydroxide solution of known concentration. Use the results to calculate the molar mass of the unknown diprotic acid, then identify it. In the extension activity, calculate the acid dissociation constants for the unknown diprotic acid.

Liquid Chromatography ● *No sensor required*

Perform an isocratic separation and a step-gradient separation using a Sep-Pak® C18 cartridge to separate the dyes (FD&C Blue and FD&C Red) from the other ingredients present in grape-flavored Kool-Aid®.

Measuring and Predicting Heats of Reaction

First, experimentally confirm Hess' law by using a Go Direct® Temperature Probe to determine the heats of three reactions. Subsequently, determine the temperature changes associated with two reactions: magnesium oxide (MgO) with hydrochloric acid (HCl), and magnesium (Mg) with HCl. Use the results to calculate the heat of combustion of a Mg ribbon using Hess' law.

Molar Volume of a Gas

React a known mass of solid magnesium (Mg) with an excess of hydrochloric acid (HCl) in a sealed vessel to produce hydrogen gas (H_2). Use a Go Direct® Gas Pressure Sensor to measure the pressure increase in the sealed vessel, and a Go Direct® Temperature Probe to measure the temperature of the reaction indirectly. Finally, use the combined gas law to calculate the volume of H_2 produced at nonstandard conditions. In the extension activity, investigate the effect of temperature change on the volume of a fixed molar amount of H_2.

Properties of Solutions: Electrolytes and Nonelectrolytes

Use a Go Direct® Conductivity Probe to measure the conductivity of aqueous solutions containing strong, weak, and nonelectrolytes. Determine if the compounds have dissociated, and if so, whether this dissociation is complete or partial. In the extension activity, investigate the relationship between conductivity and strong and weak bases.

Rate Law Determination

Use a Go Direct® SpectroVis® Plus Spectrophotometer to observe the reaction between crystal violet and sodium hydroxide, and study the relationship between the concentration of crystal violet and the time elapsed during the reaction. Determine the observed rate constant, k_{obs}. In the extension activity, determine the half-life of this reaction.

Standardising a Solution

Standardise a solution of sodium hydroxide (NaOH) with potassium hydrogen phthalate ($KHC_8H_4O_4$) as the primary standard. Titrate $KHC_8H_4O_4$ against NaOH while simultaneously monitoring the pH change of the solution using the Go Direct® pH Sensor. Use the change in pH to determine the concentration of the NaOH solution. In the extension activity, examine measurement uncertainties.

Synthesis and Analysis of Aspirin

Synthesise aspirin, then use two methods to test the purity of the synthesised sample. First, use a Go Direct® Melt Station to determine the sample's melting point and use these data to calculate the percent yield. Subsequently, use a Go Direct® SpectroVis® Plus Spectrophotometer to measure the absorbance of a set of standard solutions of salicylic acid to establish a standard curve. Determine the amount of salicylic acid (impurity) in the aspirin sample using Beer's law.

Temperature and State Changes

Use the Go Direct® Temperature Probe to collect data as you freeze, melt, and boil water. Graph the temperature curves associated with these state changes. Perform research to relate molecular structure and intermolecular forces to the boiling points of other molecules. In the extension activity, supercool samples of sodium thiosulfate pentahydrate and discuss this phenomenon in terms of crystallisation and heat release.

How can Lt help?

Educators

Easy lesson authoring
Building media-rich lessons is simple. Drag-and-drop a range of content types to create interactive exercises, including multiple choice questions, short form written answers, and image annotation.

Collaborative
Share content and workload with your fellow educators and teaching assistants. Set varying levels of access to allow others to review content, add content, or publish revisions online.

Flexible grading
Automatically grade quizzes while keeping the flexibility to add feedback and positive reinforcement, and manually grade written assessments.

Supporting your Lt journey
When you sign up to Lt, you become part of our global community of Lt collaborators. We provide you with ongoing support, including a dedicated Customer Success Manager during onboarding and beyond to ensure you're meeting your teaching objectives.

Students

Learn anywhere
Lt's cloud-based platform means students can learn on almost any device that connects to the internet. Whether they use iOS or android, tablet, mobile, or laptop, lessons will be resized and optimised to look great.

Go Direct® sensor integration
In the lab, students can record and view chemical signals live on screen with Vernier's suite of Go Direct® sensors. The sensors are integrated with data sampling panels in Lt that can record temperature, gas pressure, spectral profile, pH, and more.

Remote learning
Each chemistry lab has a Distance Learning version. Labs include built-in, pre-recorded example data that students can access for data analysis, meaning students can achieve the desired learning outcomes even if they lack access to sensors or a laboratory space.

90-DAY FREE TRIAL
Sign up now **adi.to/lt**

Administration

Simple setup
Lt needs only an internet browser to allow course administration, authoring, and publishing. Our data acquisition app, used for sampling, installs in 30 seconds.

Analytics
Our analytics allow you to view class progress in each lesson and across your course, and provide valuable insights about where and how students are interacting with course material.

Secure and scalable
Totally secure, Lt is hosted on Amazon Web Service's encrypted servers with guaranteed 99% uptime and the ability to maintain speed as more students login to Lt.

Future proof
Lt is automatically updated with new features by our team of engineers, developers, and education specialists.

Getting started with Lt

Custom training and specialist support
Whether you need help with lab installation and setup, IT training, Lt training or specialised support, we can get you up and running even faster with an add-on package of training and support services.

For more information contact your local representative at **info@animalab.eu** or visit **www.animalab.eu**

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