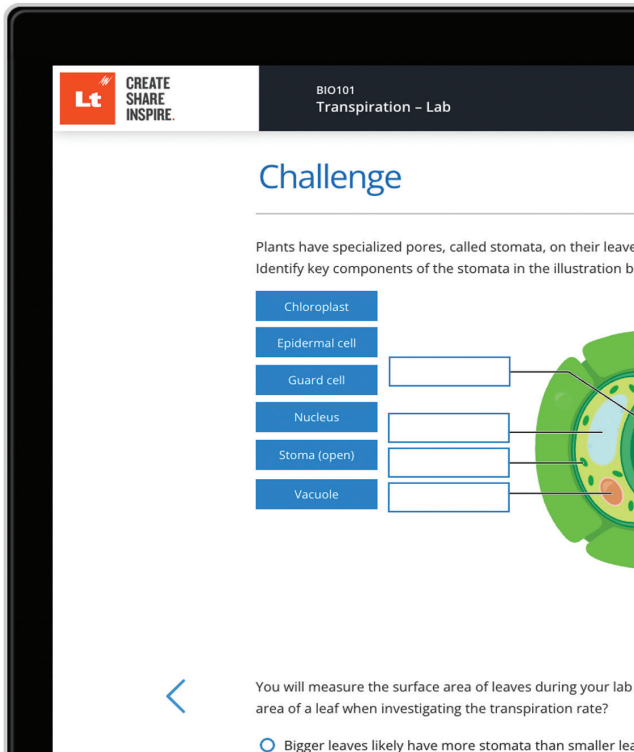
CREATE
SHARE
INSPIRE.

Biology Collection Overview

Engage students with hands-on experiments and core concepts



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

The Lt Biology Collection includes 34 labs that encourage students to investigate core biological concepts through real-time authentic data collection and guided inquiry.

Developed in partnership with Vernier® Science Education and Bio-Rad™ Laboratories, these labs address popular topics in Introductory Biology. Interactive content, integrated with Vernier's Go Direct® Sensors and Bio-Rad's robust biotechnology kits, promotes active learning and engagement.

Designed with Core Competencies in Mind

Media-rich labs align with core competencies for undergraduate biology students* and promote scientific literacy by asking students to predict outcomes, collect and analyze real data, and draw evidence-supported conclusions.

Bloom's taxonomy has been used to design diverse and rigorous assessment, and real-world applications of biological concepts increase relevancy.

**Vision and Change in Undergraduate Education: A Call to Action* report, AAAS.

Supporting Students at Different Skill Levels

Many of the editable biology labs include optional, guided-inquiry extensions that increase academic rigor and promote scientific competencies.

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

Developed in partnership with

Vernier® SCIENCE EDUCATION

Vernier® Science Education's award-winning technology, software, and data-analysis tools are trusted by educators worldwide.

BIO-RAD

Innovative kits from Bio-Rad™ Laboratories equip students with foundational skills and make scientific discovery accessible.

> *"The photosynthesis labs [in Lt] were perfect."*
>
> - **Corban Goodman,**
> Laboratory Coordinator,
> La Sierra University, USA

ADINSTRUMENTS

Please note that 18 of the 34 labs have been developed for use with Vernier Go Direct® Sensors. To use Vernier Go Direct® Sensors with Lt, you will need to download the kuraCloud Desktop Application from the ADInstruments website. In the absence of sensors, students can analyze example data in Lt. Please see the Example Data brochure for details.

Acid Rain ●●

Use a Go Direct® pH Sensor to measure changes in pH when carbon dioxide is dissolved in distilled water, and when H_2SO_4 is dissolved in distilled, fresh, and salt water, as well as a buffer.
OPTIONAL EXTENSION: Investigate how dissolved H_2SO_4 affects the pH of hard and soft water.

Animal Behavior ●

Observe behavior in *Porcellio* and *Drosophila*. Develop and test predictions as to whether *Porcellio* have adapted to perceive and react to certain environmental changes.

Aquatic Photosynthesis ●

Use a Go Direct® Optical Dissolved Oxygen Probe to measure the dissolved oxygen concentration in water containing an aquatic moss under various light conditions (darkness, full spectrum, blue, and red light). Determine whether aquatic plants perform photosynthesis or cellular respiration under these conditions.

Bacterial Transformation ●●

Use a Bio-Rad™ pGLO Bacterial Transformation Kit to genetically transform *Esherichia coli (E. coli)*, so that the bacteria incorporate the green fluorescent protein (GFP) gene and fluoresce when exposed to arabinose and ultraviolet or blue light.
OPTIONAL EXTENSION: Investigate a research question of your choice.

Biological Membranes ●

Use a Go Direct® SpectroVis® Plus Spectrophotometer to investigate the effects of pH, temperature, detergent, and alcohols on biological membranes.

Cellular Respiration ●●

Use a Go Direct® CO_2 Gas Sensor to investigate whether germinating and non-germinating peas respire. Determine whether temperature affects the rate of respiration.
OPTIONAL EXTENSION: Investigate a research question of your choice.

CRISPR ●●

Use a Bio-Rad™ Out of the Blue CRISPR Kit to edit the *lac*Z gene in bacteria. Perform blue-white screening to confirm gene editing.
OPTIONAL EXTENSION: Identify a genetic disease and perform a BLAST search to find a target site. Discuss the ethical considerations of CRISPR.

Diffusion through Membranes ●●

Use a Go Direct® Conductivity Probe to measure the diffusion rate of salts in solution and determine how changes in the concentration gradient and the presence of other molecules affect the diffusion rate of salt across a membrane.
OPTIONAL EXTENSION: Investigate a research question of your choice.

DNA Structure and Replication ●

Use models to examine the structure of deoxyribonucleic acid (DNA), how DNA molecules are compacted into chromatin, and how DNA is replicated. Explore ways in which errors are detected and corrected.

Ecology and Biodiversity ●

Sample and assess biodiversity in different ecosystems. Carry out an alpha, beta, and gamma assessment of chosen ecosystems. Examine species evenness, calculate Shannon equitability values, and examine how diversity changes over time.

ELISA: Giant Panda Problem ●●●

Use a Bio-Rad™ Giant Panda Problem Kit to perform an indirect ELISA on mock panda urine samples. Help caretakers determine which female pandas are nearing their fertility window – an important step in the conservation of giant pandas as a species.
OPTIONAL EXTENSION: Research and engage with the ethical dilemmas of antibody production techniques.

Enzyme Action: Testing Catalase Activity ●●

Investigate how the concentrations of enzyme and substrate influence the reaction rate of catalase. Use a Go Direct® O_2 Gas Sensor to measure the concentration of oxygen gas formed as hydrogen peroxide is broken down.
OPTIONAL EXTENSION: Investigate a research question of your choice.

Exploring the Greenhouse Effect ●●

Use Go Direct® Temperature Probes to observe the greenhouse effect by measuring temperatures in model greenhouse and control beakers. Examine how carbon dioxide affects temperature within a model greenhouse.
OPTIONAL EXTENSION: Perform a guided experiment to determine how different terrains reflect heat.

Forensic DNA Fingerprinting ●●●

Use a Bio-Rad™ Forensic DNA Fingerprinting Kit to analyze DNA found at a crime scene and from five suspects (fictional). Present the results to the "court" (the class).
OPTIONAL EXTENSION: Consider the importance of information literacy.

From DNA to Protein ●

Use a model to explore the processes of DNA transcription and translation. Understand and differentiate mutation types. Investigate a sickle cell disease case study to understand how mutations can lead to diseases.

Key: ● *Data acquisition (DAQ) with Vernier Go Direct® Sensor(s)* ● *Non-DAQ (no sensor required)* ● *Uses Bio-Rad™ Kit* ● *Includes Extension*

Genetics of Drosophila ●

Demonstrate basic genetic principles using the model organism *Drosophila melanogaster*. Use Punnett squares to draw conclusions about what sort of cross has occurred and calculate chi-square statistics to test null (H0) and alternative (H1) hypotheses.

Interdependence of Plants and Animals ●

Use a Go Direct® pH Sensor and a Go Direct® Optical Dissolved Oxygen Probe to investigate how oxygen and carbon dioxide are exchanged among plants, snails, and surrounding water, in both light and dark conditions.

Introduction to Cells ●

Investigate the defining characteristics of prokaryotic and eukaryotic cells using a compound microscope and wet mount techniques. Consider how structure influences cell function. Classify cells from "mystery organisms" as bacteria, protist, plant, or animal.

Introduction to Microscopy ● ●

Learn how to safely use a compound microscope to observe both inanimate objects and more complex biological specimens.

OPTIONAL EXTENSION: Prepare and observe a wet mount.

Introduction to Molecular Evolution ● ● ●

Use morphological observation to construct an initial cladogram of the relationships between five animals. Use the Bio-Rad™ Comparative Proteomics I: Protein Profiler Kit to perform SDS-PAGE analysis to compare protein profiles, and refine the cladogram using these molecular data.

OPTIONAL EXTENSION: Propose hypotheses and conduct independent research into a selected topic relating to apparently maladaptive behavior. Select and justify strategies for communicating results to specific audiences.

Limitations on Cell Size ●

Use a Go Direct® Conductivity Probe and agar cubes as cell models to investigate how altering surface area while maintaining constant volume affects the rate of material exchange with the environment.

Macromolecules: Proteins ● ●

Use a Go Direct® SpectroVis® Plus Spectrophotometer to perform a Bradford assay and a biuret assay. Compare the two assays to determine their respective abilities to detect proteins and amino acids.

OPTIONAL EXTENSION: Use a Go Direct® pH Sensor to determine the properties of different amino acids.

Measuring Primary Productivity ● ●

Use a Go Direct® Optical Dissolved Oxygen Probe to measure the production of oxygen in water samples exposed to different levels of light. Use the measured changes in dissolved oxygen to calculate how much photosynthesis is occurring in the samples.

OPTIONAL EXTENSION: Investigate a research question of your choice. Explore the biological and interdisciplinary issues related to three case studies: carbon accreditation, eutrophication, and rewilding.

Metabolization of Sugars by Yeast ● ●

Use a Go Direct® CO_2 Gas Sensor to determine how the metabolization rate of yeast changes with glucose concentration, and whether yeast are capable of metabolizing a variety of sugars (sucrose, glucose, fructose, and lactose).

OPTIONAL EXTENSION: Investigate a research question of your choice.

Mitosis and Meiosis ●

DISTANCE LEARNING LAB: Draw each stage in the processes of mitosis and meiosis. Explore sources of genetic variability and errors in cell division. Examine histological slides, and compare and contrast the processes of mitosis and meiosis.

LAB: Investigate different ways that cells divide, and find out what happens when errors occur during these complex processes. Examine mitosis using both plant and animal cells, model the phases of meiosis with clay, observe meiosis in a lily anther, and learn about the sources of genetic variation and potential errors during meiosis.

Modeling Population Dynamics ● ●

Model the growth of populations over time and observe the effects of species interactions. Explore simple exponential growth, carrying capacity, and the effects of competing herbivore species and predator species.

OPTIONAL EXTENSION: Examine how a herbivore population is affected by decomposers.

Osmosis ●

Use a Go Direct® Conductivity Probe to measure changes in the conductivity of a variety of salt solutions containing potato samples. Use these values to calculate the relative tonicities of the salt solutions. Examine the responses of *Elodea* cells to solutions of varying tonicity.

Photosynthesis ● ●

Use a Go Direct® SpectroVis® Plus Spectrophotometer to measure the effects of darkness and heat on photosynthetic rate. Use atrazine to observe how inhibitors affect photosynthesis.

OPTIONAL EXTENSION: Investigate a research question of your choice.

Polymerase Chain Reaction (PCR) ● ●

Use a Bio-Rad™ PV92 PCR Informatics Kit along with real-world forensic techniques to extract DNA from hair follicles or cheek cells. Use PCR amplification and electrophoresis to fingerprint DNA at a specific genetic locus. Test the Hardy-Weinberg equilibrium theory within the classroom population, and compare class results to a larger population.

Population Dynamics ● ●

Monitor yeast population growth by measuring the turbidity of a solution with a Go Direct® SpectroVis® Plus Spectrophotometer and performing yeast cell counts using a microscope.

OPTIONAL EXTENSION: Investigate a research question of your choice.

Population Genetics and Evolution ●

Key: ● *Data acquisition (DAQ) with Vernier Go Direct® Sensor(s)* ● *Non-DAQ (no sensor required)* ● *Uses Bio-Rad™ Kit* ● *Includes Extension*

Investigate a genetically-inherited trait, calculate allele frequencies using the Hardy-Weinberg formula, and compare classroom allele frequencies to North American averages Examine the effects of natural selection, heterozygous advantage, and genetic drift on allele frequencies.

The Visible Spectra of Plant Pigments ●

Use a Go Direct® SpectroVis® Plus Spectrophotometer to measure the visible absorbance spectra of plant pigments and synthetic colorings.

Transpiration ●●

Use a Go Direct® Gas Pressure Sensor to ascertain the transpiration rates of woody-stemmed plants under control and experimental conditions. Investigate how altering an environmental variable (light, humidity, temperature, or air movement) impacts transpiration rate.

OPTIONAL EXTENSION: Use a compound microscope to complete stomatal counts, and relate the counts to plants' environments.

Turnip Peroxidase ●●

Use a Go Direct® SpectroVis® Plus Spectrophotometer to investigate how enzyme and substrate concentrations affect the rate of peroxidase-catalyzed reactions. Determine V_{max}, ½ V_{max}, and K_m using a Lineweaver–Burk plot.

OPTIONAL EXTENSION: Investigate a research question of your choice.

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.

Onboarding

Our Instructional Design team can convert and edit your existing content and lessons to make them even better in Lt.

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 optimized to look great.

Go Direct® Sensor integration

In the lab, students can record and view authentic biological data live on screen with Go Direct® Sensors and sampling panels in Lt that can record spectral data, O_2, CO_2, pH, and more.

Learn from real patients

For future health professionals, our patient cases allow students to follow a real patient from initial presentation to diagnosis and management. Expert healthcare professionals provide their views throughout the journey and students can practice note-taking and reflection.

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 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 specialized support, we can get you up and running even faster with an add-on package of training and support services.

Lt

90-DAY FREE TRIAL

Sign up now **adi.to/lt**

Visit **adinstruments.com** or contact your local ADInstruments representative for more information

Australia | Brazil | Europe | India | Japan | China | Middle East | New Zealand | North America | Pakistan | South America | South East Asia | United Kingdom

adinstruments.com

ADINSTRUMENTS