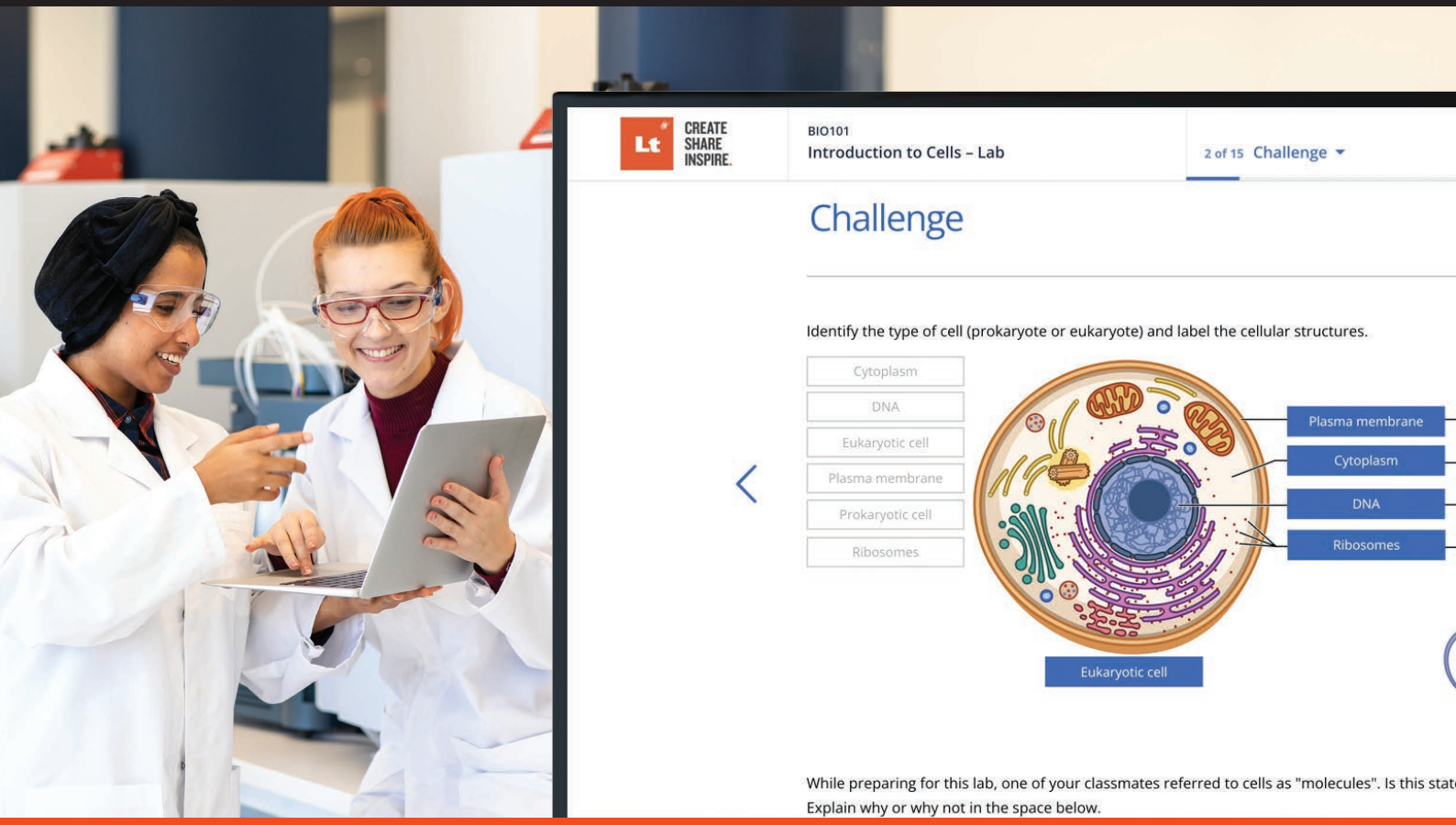
CREATE
SHARE
INSPIRE.

Lt Biology Collection

Engage students with hands-on experiments and core concepts



Lt is an interactive online lab manual and learning platform that engages students with real data, inside and outside the lab.

The Lt Biology Collection includes 34 customizable and professionally-designed labs that reinforce concepts across a wide range of topics including **cell biology, genetics, evolution, ecology, biochemistry, and more.**

Lt Biology content can be used for **pre-lab preparation, in-lab practical work, and post-lab reports or extended learning tasks - all in one platform!**

Real-time Data Collection

Students investigate core biological concepts through real-time, authentic data collection. Labs integrate with Vernier Go Direct® Sensors or Bio-Rad™ kits to provide a practical learning experience for your students in the laboratory, or use Lt's pre-recorded example data for remote learning situations.

Supporting Students at Different Skill Levels

Differentiation and scaffolding are made easy as many labs include guided inquiry extensions, allowing students to choose and investigate a research question by:

- making a prediction
- designing an experiment
- collecting and analyzing data

Me and my students loved the Mitosis and Meiosis lab! All activities that my students did satisfied our learning objectives. The editing part was very easy and user-friendly.

Idelisa Ayala,
Associate Professor Biological Science, Broward College

Developed in partnership with

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

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

ADINSTRUMENTS

Please note that 18 of the 34 labs have been developed for use with Vernier Go Direct® Sensors. In the absence of sensors, students can analyze example data in Lt. Please see the Example Data brochure for details.

Cell Biology

Biological Membranes ●

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

Diffusion through Membranes ● ●

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 using a Go Direct® Conductivity Probe.

ELISA ● ● ●

Perform an indirect ELISA on mock panda urine samples using a Bio-Rad™ Giant Panda Problem Kit and 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.

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.

Limitations on Cell Size ●

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

Mitosis and Meiosis ●

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.

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.

Genetics

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.

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.

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.

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.

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.

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.

Biochemistry and Metabolism

Aquatic Photosynthesis ●

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

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.

Enzyme Action ● ●

Investigate how the concentrations of enzyme and substrate influence the reaction rate of catalase. Use a Go Direct® O2 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.

Macromolecules: Proteins ● ●

Perform a Bradford assay and a biuret assay using a Go Direct® SpectroVis® Plus Spectrophotometer. 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.

Metabolization of Sugars by Yeast ● ●

Determine how the metabolisation rate of yeast changes with glucose concentration, and whether yeast are capable of metabolising a variety of sugars (sucrose, glucose, fructose, and lactose), using a Go Direct® CO_2 Gas Sensor.

Photosynthesis ● ●

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

Turnip Peroxidase ● ●

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

Ecology

Acid Rain ● ●

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, using a Go Direct® pH Sensor.
OPTIONAL EXTENSION: Investigate how dissolved H_2SO_4 affects the pH of hard and soft water.

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.

Exploring the Greenhouse Effect ● ●

Observe the greenhouse effect by measuring temperatures in model greenhouse and control beakers, using Go Direct® Temperature Probes. Examine how carbon dioxide affects temperature within a model greenhouse.

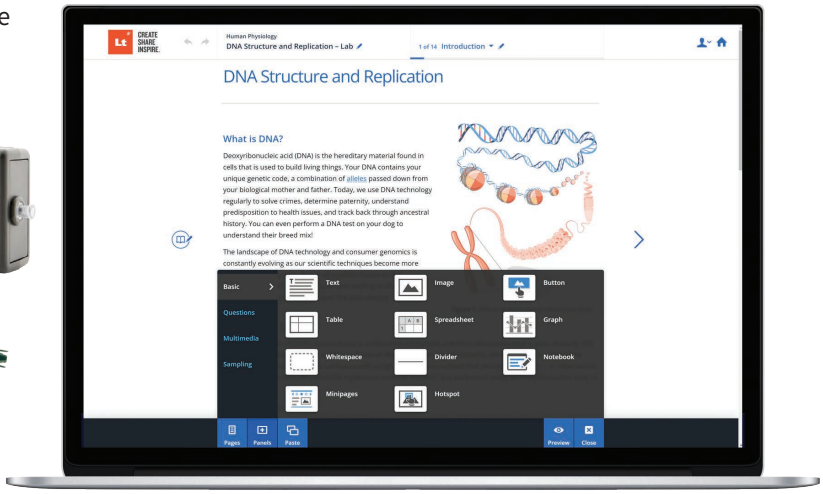
OPTIONAL EXTENSION: Perform a guided experiment to determine how different terrains reflect heat.

Measuring Primary Productivity ● ●

Measure the production of oxygen in water samples exposed to different levels of light using a Go Direct® Optical Dissolved Oxygen Probe. 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.

The Visible Spectra of Plant Pigments ●

Measure the visible absorbance spectra of plant pigments and synthetic colorings using a Go Direct® SpectroVis® Plus Spectrophotometer.



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

Evolution

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.

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.

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.

Population Genetics and Evolution

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.

Interactions of Animals, Plants, and the Environment

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.

Interdependence of Plants and Animals

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

Transpiration

Determine the transpiration rates of woody-stemmed plants under control and experimental conditions using a Go Direct® Gas Pressure Sensor. 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.

How can Lt help?

Educators

Easy lesson authoring
Drag-and-drop interactive elements, 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, we provide you with ongoing support, including a dedicated Customer Success Manager.

Students

Learn anywhere, anytime
Lt's cloud-based platform means students can learn on iOS or Android, tablet, mobile, or laptop.

Go Direct® Sensor integration
Students can record and view authentic biological data live on screen in Lt with Go Direct® Sensors that can record absorbance spectra, O_2, CO_2, pH, and more.

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
View class progress in each lesson and section in your course, and gain valuable insights about where and how students interact 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 sign in to Lt.

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