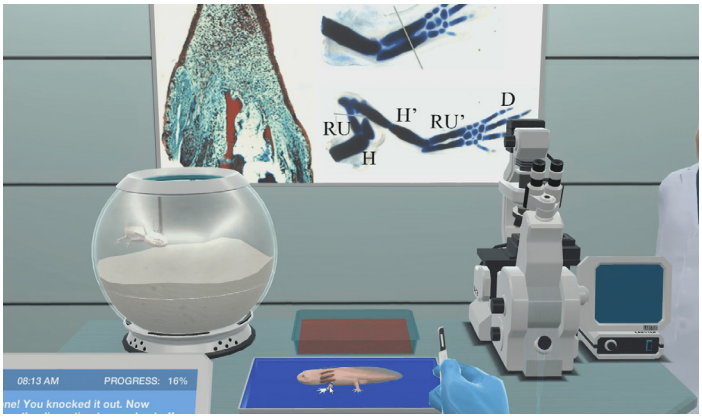
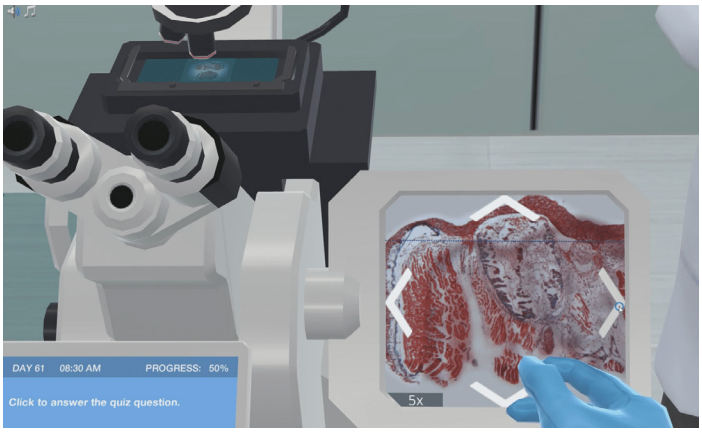
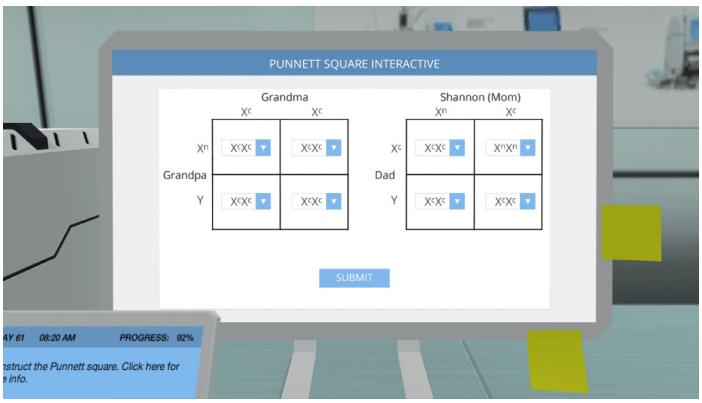
Labster Virtual Lab Simulations for Biochemistry







Labster is a world-leading provider of virtual lab simulations for higher education and high schools.

The simulations are designed to let students learn by doing in a virtual laboratory, solving real-case problems. Quiz questions test the students' knowledge, supporting an inquiry-based and deep-learning approach. The students will train real lab skills in a safe virtual environment where they can safely make mistakes, and learn at their own pace.

The most basic simulations are ideal as a self-study activity since the students will review essential concepts. The more advanced simulations are designed to support the course syllabus, reinforcing concepts and giving the students an innovative tool to deepen their learning.

Labster

University Biochemistry Simulations

Includes 29 simulations:

- Acids and Bases
- Antibodies
- Cancer Pharmacology
- Carbohydrates
- Cellular Respiration
- ELISA
- Enzyme Kinetics
- FACS
- Fermentation
- Flow Injection Analysis
- Hematology
- Homogenization
- HPLC
- Intro to Organic Chemistry
- Introduction to Food Macromolecule
- Ionic and Covalent Bonds
- Nuclear Magnetic Resonance
- Parkinson's Disease
- Pasteurization and Sterilization
- Periodic table [Q2 '19]
- Pigment Extraction
- Pipetting
- Plant Transcriptomics
- Protein Denaturation
- Protein Synthesis
- RNA Extraction VR (from GEL)
- Solution Preparation
- Stoichiometry and Chemical Equilibrium [Q2 '19]
- Synthetic Biology

Ready to learn more?

Bring the world of science into the classroom and enable students to bring learning home with Labster's virtual science lab content. No need for additional hardware or lab equipment; access these labs on Chromebooks or any other laptops, and spark creativity in students with this innovative and interactive way to explore science.

It's a million-dollar lab, one click away.

To learn more about how you can incorporate Labster virtual labs in your teaching, visit us at www.labster.com.

Learning objectives covered in Labster's biochemistry simulations

Acids and Bases

Learning objectives: At the end of this simulation you will be able to...

- Give examples of acids and bases from everyday life
- Define pH and identify acids and bases using the pH scale
- Apply the the Bronsted-Lowry definition of acids and bases to chemical compounds
- Describe the amphoteric and self-ionization capacity of water
- Calculate the pH of a strong acid and base in solution
- Assess whether a neutralization reaction will occur
- Evaluate the outcome of simple acid-base reactions

Antibodies

Learning objectives: At the end of this simulation you will be able to...

- Understand the structure and function of antibodies:
  - Different isotypes
  - Different parts of an antibody
- Understand the formation of antibody-antigen complex:
  - Types of interaction between antibody and antigen
- Understand the role of different blood types:
  - ABO and rhesus factor
  - Blood typing by using Eldon cards
  - Blood transfusions
  - Rhesus incompatibility and hemolytic disease of a newborn (HDN)

Cancer Pharmacology

Learning objectives: At the end of this simulation you will be able to...

- Understand the principles and limitations of chemosensitivity testing in the context of in vitro based anticancer drug screening
- Conduct, analyze and interpret in vitro chemosensitivity tests using the MTT assay
- Evaluate the advantages and disadvantages of chemosensitivity tests for in vitro based screening programs
- Prepare cell cultures for chemosensitivity testing
- Determine viable cell numbers using an automated cell counter
- Conduct the MTT assay to assess cell survival following drug exposure
- Generate dose response curves and determine half-maximal effective concentration (EC50) values
- Interpret the results obtained in the chemosensitivity assay
- Understand the mechanisms of action of cyclophosphamide and epirubicin

Carbohydrates

Learning objectives: At the end of this simulation you will be able to...

- Understand the molecular structure of sugars and polysaccharides
- Understand digestion and appreciate the complexity of the human body
- Experiment with different foods and measure their impact on the blood sugar levels

Cellular Respiration

Learning objectives: At the end of this simulation you will be able to...

- Explain the structural changes of glucose and ATP during glycolysis
- Analyze blood glucose and lactic acid concentrations of athletes before and after exercise
- Determine electron carrier products of the Krebs cycle
- Understand the role of the electron transport chain in generating ATP
- Experiment on oxygen consumption in mice at various exercise intensities

ELISA

Learning objectives: At the end of this simulation you will be able to...

- Explain the principle of different ELISA techniques
- Apply sandwich ELISA to quantify protein samples
- Analyze the standard curve of ELISA experiment
- Understand the function of reagents and equipment used in ELISA
- Describe the basic troubleshooting process of ELISA

Enzyme Kinetics

Learning objectives: At the end of this simulation you will be able to...

- Understand the experimental design of enzyme kinetics
- Understand the Michaelis-Menten model of enzyme kinetics
- Analyze spectrophotometer data and calculate Km and Vmax
- Understand that kinetics of an enzyme can be modified by genetic mutations
- Understand inhibition kinetics by using several types of inhibitors

FACS

Learning objectives: At the end of this simulation you will be able to...

- Understand the basics of flow cytometry technique
- Understand the importance of each system that the technique relies on (fluidics, optics, and electronics)
- Use a cell sorter (start up, sorting, and shut down of the equipment)
- Understand how the equipment performs the measurements
- Interpret the results and understand the applications of the technique

Fermentation

Learning objectives: At the end of this simulation you will be able to...

- Understand cell growth, goals of fermentation and application to the real-world
- Understand the function and various parts of the bioreactor and auxiliary equipment
- Understand microbial growth kinetics with examples of batch and chemostat fermentations
- Understand how parameters such as pH, temperature, aeration, and agitation affects fermentation
- Perform virtual fermentations to identify optimal process conditions

Flow Injection Analysis

Learning objectives: At the end of this simulation you will be able to...

- Measure caffeine concentration in different samples using the Flow Injection Analysis (FIA) technique
- Describe the importance of the different parts of the FIA machine (e.g. the spectrophotometer, the pump, or the mixing coil)
- Describe the advantages of the FIA method
- Calculate the velocity at which a sample will be eluted
- Prepare sample dilutions and standard curves
- Interpret the results from a FIA experiment
- Determine the concentration of an unknown caffein sample by using the standard curve

Hematology

Learning objectives: At the end of this simulation you will be able to...

- Understand the organisation of a hematology laboratory, equipment selection and lab safety
- Understand the principles, application, and limitations of selected hematological tests in relation to clinical problems
- Select an appropriate test and interpret laboratory data in relation to a clinical problem

Homogenization

Learning objectives: At the end of this simulation you will be able to...

- Understand the different types of mixtures present in food
- Understand the role of emulsifiers
- Understand the molecular structure of milk
- Remember the steps of homogenization and how a homogenizer works

HPLC

Learning objectives: At the end of this simulation you will be able to...

- Understand the different compartments of an HPLC machine and functions
- Understand the principles of HPLC separation
- Understand the lipophilic interaction between the analyte and the mobile and stationary phase
- Understand the different changes in parameters (such as the column, mobile phase, temperature etc.) and its effects on analyte separation and concentration measurements

Intro to Organic Chemistry

Learning objectives: At the end of this simulation you will be able to...

- Give examples of uses of organic compounds
- Identify the carbon valence electrons and the hybridization of their orbitals
- Predict the angles of covalent bonds of carbon atoms in hydrocarbons
- Apply the nomenclature of simple hydrocarbons
- Interpret some of the important representations of hydrocarbons
- Give examples of functional groups of organic compounds and their reactions

Introduction to Food Macromolecules

Learning objectives: At the end of this simulation you will be able to...

- Understand the types of macromolecules found in food
- Understand the structure of carbohydrates, proteins, and lipids
- Detect macromolecules in food samples

Ionic and Covalent Bonds

Learning objectives: At the end of this simulation you will be able to...

- Describe the formation of ionic and covalent bonds
- Identify anions and cations
- Apply the octet rule
- Describe ionic lattice structure
- Draw Lewis dot structures
- Explain the formation of single, double, and triple bonds
- Distinguish between ionic compounds and covalent compounds

Nuclear Magnetic Resonance

Learning objectives: At the end of this simulation you will be able to...

- Understand how to perform NMR experiments
- Understand how to analyze NMR spectra

Parkinson's Disease

Learning objectives: At the end of this simulation you will be able to...

- Describe the role of alpha synuclein in Parkinson's disease
- Describe the different parts of a liquid chromatography equipment
- Interpret results from liquid chromatography experiments
- Describe the difference between Ion Exchange Chromatography and Size Exclusion Chromatography
- Evaluate the mode of action of Epigallocatechin gallate on Lewy body formation
- Describe the benefits of using Large Unilamellar vesicles as a cell membrane in vitro model

Pasteurization and Sterilization

Learning objectives: At the end of this simulation you will be able to...

- Understand the concept of food spoilage and shelf life
- Understand the principle of pasteurization and sterilization
- Analyze the parameters of High-Temperature-Time-Treatment (HTST) pasteurization
- Perform canning as a method of sterilization
- Understand how plastic and metal can be used as materials for packaging

Periodic table

Learning objectives: At the end of this simulation you will be able to...

- Describe the structure and organization of the periodic table (atomic number, element name, atomic weight, metal/non-metal/metalloids)
- Describe the main trends among groups and periods of the periodic table (Atomic Radii, Ionization Energy, Electronegativity, Metallic Character)
- Explain the reasons for the following trends among groups and periods in the periodic table (Atomic Radii, Ionization Energy, Electronegativity)
- Use the flame color test to identify metals based on their position in the periodic table
- Give an overview of the oxidation states (maybe give only examples for Halogens and alkali metals)
- Explain the main properties and differences between Transition Metals vs. Main Group Elements
- Determine the metallic characteristics (shininess, magnetism, electrical conductivity)

Pigment Extraction

Learning objectives: At the end of this simulation you will be able to...

- Understand the importance and uses of photosynthesis
- Understand properties of light and why pigments are colorful
- Analyze the absorbance spectra and chemical properties of pigments
- Develop a hypothesis and set up an experiment to test it

Pipetting

Learning objectives: At the end of this simulation you will be able to...

- Select the correct micropipette for its purpose
- Use the two stops of the pipette
- Explain pipetting techniques
- Perform a serial dilution
- Quantify the protein content in a sample with a Bradford assay

Plant Transcriptomics

Learning objectives: At the end of this simulation you will be able to...

- Understand terpenoid and its benefit as an antimalarial drug
- Understand how Next Generation Sequencing technology can be used to screen candidate genes
- Use BLAST and phylogenetic analysis gene annotation

Protein Denaturation

Learning objectives: At the end of this simulation you will be able to...

- Understand what protein denaturation is
- Understand how interactions between side groups influence the protein structure
- Understand the chemical causes of protein denaturation
- Understand the physical causes of protein denaturation
- Remember the steps involved in protein denaturation
- Understand the results of protein denaturation and how food texture changes as a result of it (coagulation)
- Understand how biotechnology is used in daily life

Protein Synthesis

Learning objectives: At the end of this simulation you will be able to...

- Understand the translation process from mRNA to amino acid
- Understand the post-translational modification
- Understand the protein synthesis processing in the ribosome
- Understand the primary, secondary, tertiary and quaternary structures of protein
- Understand the basic principles of mass spectrometry (MALDI-TOF)

RNA Extraction

Learning objectives: At the end of this simulation you will be able to...

- Understand how to extract the total RNA from a cell
- Separate mRNA molecules specifically from the rest of the RNA

Solution Preparation

Learning objectives: At the end of this simulation you will be able to...

- Prepare an aqueous solution of known concentration from a pure salt
- Correctly use an analytical balance, a volumetric pipette, a volumetric flask, and measuring cylinder

Stoichiometry & Chemical Equilibrium

Learning objectives: At the end of this simulation you will be able to...

- Explain the relationship between mass, molecular weight, and numbers of atoms or molecules and perform calculations deriving these quantities from one another
- Perform mass-to-mass stoichiometric calculations via conversions to mole
- **TECHNIQUE** - Understand the basic steps and critical points of performing a gravimetric analysis

Synthetic Biology

Learning objectives: At the end of this simulation you will be able to...

- Engineer natural systems to perform specific functions
- Describe the fundamentals of the Gateway cloning technique and design your own biological circuit
- Explain and perform bacterial transformation, antibiotic selection and plasmid purification
- Explain and perform a restriction digest of your cloning product