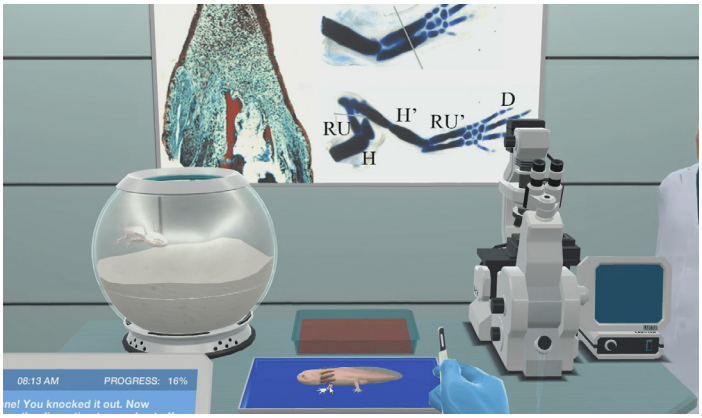
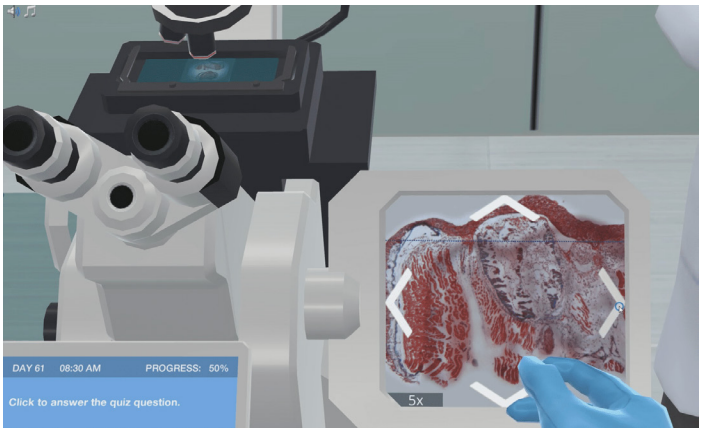
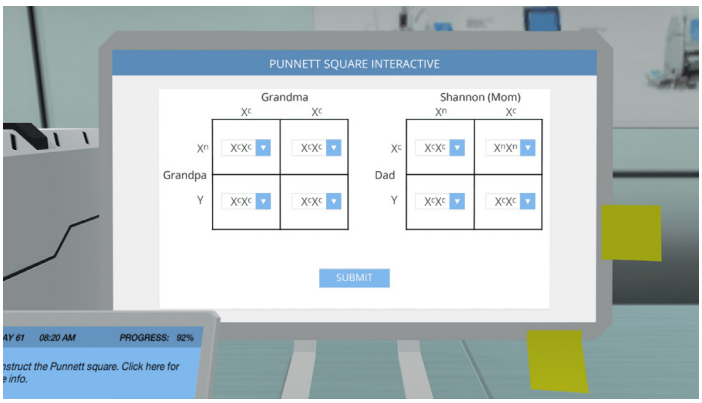
Labster Virtual Lab Simulations for General Biology







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.

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University General Biology Simulations

Includes 41 simulations:

- Acids and Bases
- Animal Genetics
- Antibodies
- Atomic Structure [Q2 '19]
- Biodiversity Simulation
- Carbohydrates
- Cellular Respiration
- Competition
- Cytogenetics
- Ecosystem Dynamics
- Electron Transport Chain (from PHS)
- Enzyme Kinetics
- Equilibrium
- Eutrophication
- Evolution
- Experimental Design
- Fermentation
- Gene Expression Unit
- Gene Regulation
- Intro to Organic Chemistry
- Introduction to Food Macromolecules
- Introductory Fermentation
- Introductory Lab
- Introductory Polymerase Chain Reaction
- Lab Safety
- Medical Genetics
- Meiosis
- Mendelian Inheritance
- Microscopy
- Mitosis
- Molecular Cloning
- Monogenic Disorders
- Next Generation Sequencing
- Periodic Table [Q2 '19]
- Pigment Extraction
- Pipetting
- Polymerase Chain Reaction
- Protein Denaturation
- Protein Synthesis
- RNA Extraction
- Signal Transduction

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 general biology 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

Animal Genetics

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

- Explain different hereditary traits and modes of inheritance
- Construct a pedigree analysis based on observed phenotypes
- Perform genome scanning to identify candidate genes for double muscling in cattle
- Develop a DNA test for double muscling in cattle

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)

Atomic Structure

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

- Explain the concept of an atom
- Explain the properties of the basic subatomic particles: protons, neutrons, and electrons
- Define atomic number and atomic mass
- Describe how the atomic number and atomic mass apply to isotopes
- Define isotopes and explain how they relate to naturally occurring element mass
- Understand the basics of the current atomic model - the quantum atomic model and describe the significance of the four quantum numbers

Biodiversity Simulation

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

- Sample for biodiversity
- Use Quadrat, camera trap and Pitfall traps
- Assess and compare biodiversity using the biodiversity index
- Identify species with a dichotomous key
- Prioritize sampling

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

Competition

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

- Identify competition between species and quantify the strength of competition between two species
- Establish evidence of competition in an agricultural environment

Cytogenetics

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

- Define medical genetic counseling, especially in the case of prenatal diagnostics
- Describe and perform an Array-based Comparative Genome Hybridization (Array CGH)
- Explain a karyotype analysis

Ecosystem dynamics

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

- Understand how the respiratory and cardiovascular system responds during exercise.
- Understand how cardiac output and blood pressure can be measured.
- Understand how heart rate, stroke volume, cardiac output and total peripheral resistance change with exercise.
- Interpret data to assess possible cardiovascular problems during exercise

Electron Transport Chain

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

- Understand the importance and uses of photosynthesis
- Understand the photolysis of water and electron transport
- Understand properties of light and why pigments are colorful
- Develop a hypothesis and set up an experiment to test it
- Understand how to measure the redox potential of the electron transport chain

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

Equilibrium

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

- Predict the directionality of reversible reactions according to Le Chatelier
- Calculate the equilibrium constant and reaction quotient
- Understand the Haber process

Eutrophication

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

- Understand the nitrogen cycle and its importance for living beings
- Understand the concept of eutrophication and harmful algal bloom, and the impact that it has on the ecosystem
- Analyze dissolved nitrogen levels in the water sample
- Understand the importance of sampling from different locations to get representative data

Evolution

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

- Understand how populations evolve by adapting to their environment
- Understand the basic mechanisms of evolution
- Understand evolution as the foundation of biology and show evidence for it
- Use DNA sequencing and phylogenetic trees to identify an unknown creature
- Deal with common misconceptions about the theory of evolution

Experimental Design

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

- Explain and apply the scientific method
- Design an experiment and test a hypothesis
- Correctly use experimental controls

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

Gene Expression Unit

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

- Prepare samples for Next Generation Sequencing
- Understand the principles behind the Next Generation Sequencing technique
- Perform a qPCR experiment with the proper controls

Gene Regulation

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

- Explain how gene expression can be regulated
- Describe the different levels of gene regulation (mRNA and protein)
- Measure mRNA levels (RT-PCR), protein expression (Western blotting)

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

Introductory Fermentation

To be confirmed.

Introductory Lab

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

- Understand the basics of safety in the laboratory
- Calculate pH of strong acids, weak acids, strong bases and weak bases
- Understand how acid dissociates in water
- Understand the principle of diffusion and osmosis
- Understand the different blood type groups and how to perform blood type test

Introductory Polymerase Chain Reaction

To be confirmed.

Lab Safety

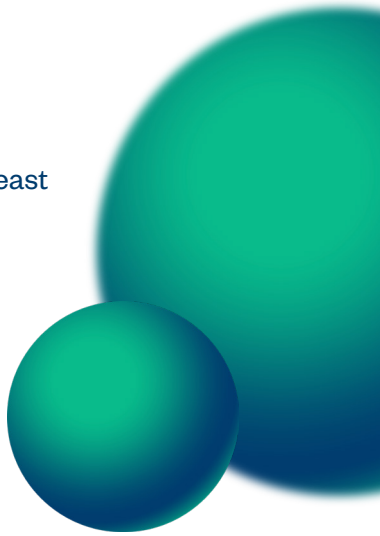
Learning objectives: At the end of this simulation you will be able to...

- Use the correct clothing to work in the lab
- Describe the do's and don'ts in a laboratory
- Correctly use the lab safety equipment
- React in an emergency situation

Medical Genetics

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

- Understand Mendelian genetics and know how to perform linkage analysis
- Perform PCR and gel electrophoresis
- Understand the basics of breast cancer, tumor suppressor, oncogenes and BRCA1/2
- Understand the genetic event underlying breast cancer



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Meiosis

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

- Understand assisted reproduction technology
- Understand the basic principle of meiosis
- Use the microscope to observe the phases of meiosis and understand their main characteristics
- Understand the main differences between mitosis and meiosis

Mendelian Inheritance

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

- Explain how traits are passed on from parents to their offspring and what causes variation between siblings
- Describe Mendel's Laws of Inheritance in color deficiency
- Compare and predict the phenotypes of offspring with given genotypes using Punnett squares
- Analyze dominant and recessive alleles, and how they play a part in an individual's biological make-up

Microscopy

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

- Understand different microscopy techniques and their limitations
- Identify various cell types and cellular structures
- Understand coeliac disease and intestinal inflammation
- Understand staining techniques

Mitosis

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

- Understand and visualize basic concepts about eukaryotic cells such as main cellular components and DNA packaging by immersive animations
- Understand the key characteristics of the cell cycle´s different stages: interphase (G1, S and G2) and mitosis
- Use different microscopy techniques to observe the phases of the mitosis and understand their main characteristics:
  - Prophase
  - Metaphase
  - Anaphase
  - Telophase
- Understand the cell cycle checkpoints and the molecules that control them (cyclins and cyclin-dependent kinases)
- Understand the main differences between mitosis and meiosis

Molecular Cloning

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

- Understand molecular cloning techniques: DNA extraction and preparation, ligation, transformation, plate streaking and antibiotic selection
- Understand inducible gene expression regulation
- Understand the use of GFP as a reporter gene
- Understand DNA damage and DNA repair system

Monogenic Disorders

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

- Understand the basic concepts of inheritance
- Build and interpret a pedigree based on family data
- Understand genetic risk assessment and counselling
- Understand the work of a genetics laboratory

Next Generation Sequencing

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

- Understand the different steps in sample preparation, cluster generation, sequencing and data processing
- Understand the characteristics of ancient DNA
- Understand that Single Nucleotide Polymorphism (SNP) can be tightly correlated to a specific physical feature

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

Polymerase Chain Reaction

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

- Explain the function of DNA polymerase in DNA replication and synthesis
- Perform a PCR experiment using DNA from a blood sample as the template
- Carry out a gel electrophoresis that separates DNA according to its size
- Interpret the unique signature of the human genome and the use of tandem repeated regions (TRR) in DNA profiling

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

Signal Transduction

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

- Explain the principles and importance of intracellular signal transduction
- Explain receptor tyrosine kinase (RTK) cell signaling
- Analyze dysregulated signal transduction in human cancer cells
- Understand the connection between angiogenesis and tumor growth
- Investigate the involvement of vascular endothelial growth factor receptor (VEGFR) signaling in human breast cancer