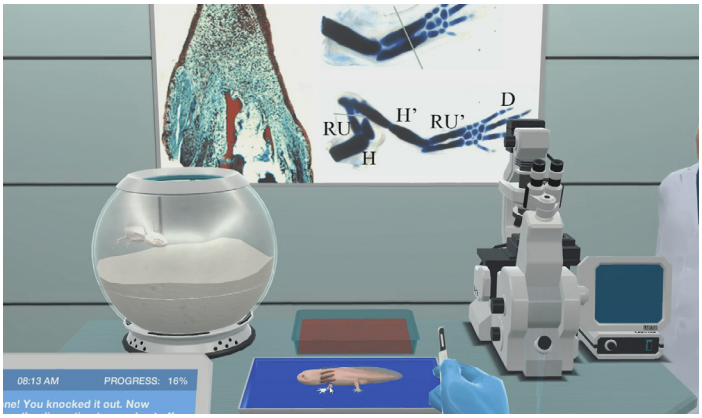
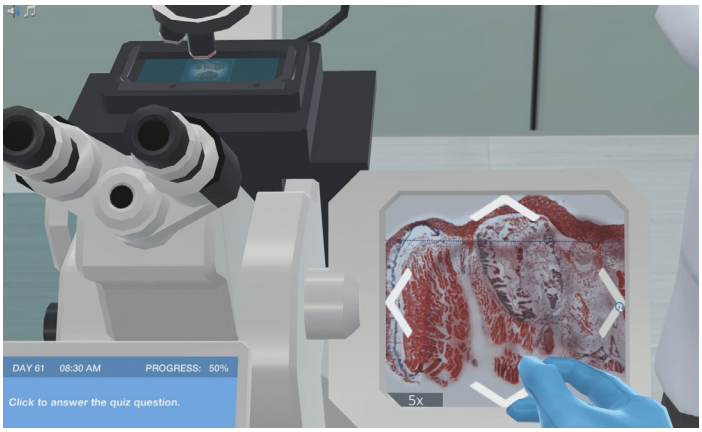
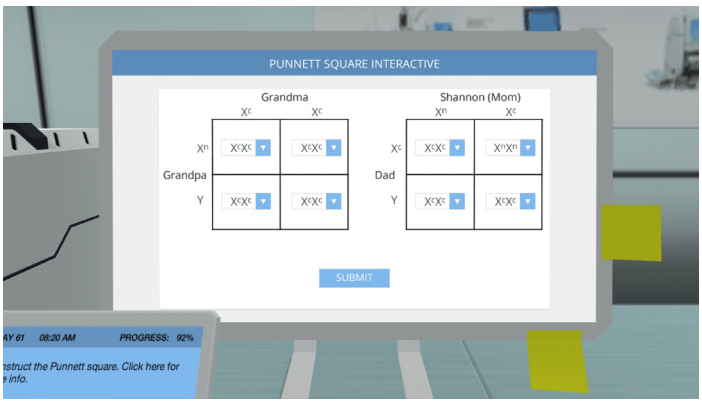
# Labster Virtual Lab Simulations for General Organic & Biology




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 Organic & Biology Simulations

### Includes 26 simulations:

- Acids and Bases
- Antibodies
- Carbohydrates
- Chemistry Safety
- Equilibrium
- Experimental Design
- Gene Expression Unit
- Gene Regulation
- Intro to Organic Chemistry
- Introduction to Food Macromolecule
- Introductory Lab
- Ionic and Covalent Bonds
- Lab Safety
- Matter and Phase Changes [Q2 '19]
- Meiosis
- Mendelian Inheritance
- Microscopy
- Mitosis
- Next Generation Sequencing
- Periodic table [Q2 '19]
- Polymerase Chain Reaction
- Protein Denaturation
- Signal Transduction
- Solution Preparation
- Stoichiometry and Chemical Equilibrium [Q2 '19]
- Your Diet and Your DNA

# 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 organic & 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

## 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)

## 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

## Chemistry Safety

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

- Understand how to create biodiesel from algal oil
- Identify the hazards posed by chemicals and how to handle them
- React quickly and save lives in case of a fire emergency
- Use the CAS numbers to plan your experiment
- Understand how to dispose of halogenated and non-halogenated waste
- Lookup H and P phrases in the safety data sheet
- Safely use a chemical fume hood

## 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

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## 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

## 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 Lab

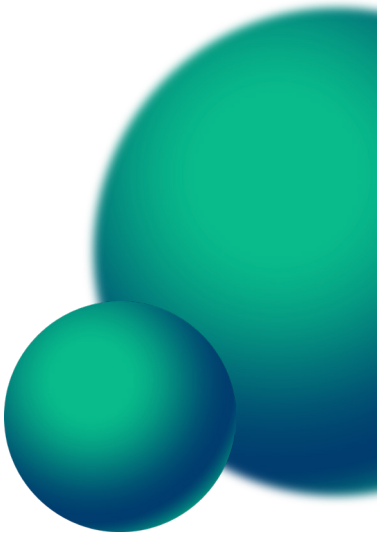
*Learning objectives: At the end of this simulation you will be able to...*

- 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

## Ionic and Covalent Bonds

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

- Understand basic concepts of sample collection
- Perform fish necropsy and learn the information you can get from this kind of approach
- Understand the concepts of trophic levels, trophic pyramids and the energy flow in an ecosystem
- Understand the difference between heterotroph and autotroph organisms
- Analyze the level of dissolved oxygen level in your water sample using a spectrophotometer
- Understand the concepts of calibration curve, linear regression and extrapolation



## 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

## Matter and Phase Changes [Q2 '19]

*To be confirmed.*

## 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

## 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)

## 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

## 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

## 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

## Your Diet and Your DNA

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

- Describe nutrient compositions of healthy and unhealthy diets
- Explain how genomic instability may lead to the development of diseases such as cancer
- Summarize the impact of diet on genomic stability