



**PraxiLabs**  
Virtual World of Science Education

# 3D PHYSICS SIMULATIONS PORTFOLIO

Biology

Chemistry

Physics



Africa's Business  
**Heroes**

**Award Winner**

[www.praxilabs.com](http://www.praxilabs.com)



# Experiments Index

## Heat and Thermodynamics

- Specific Heat of Solids ..... 1
- Boyle's Law of Gases ..... 1
- Joule's Experiment ..... 1

## Mechanics

- Free Fall ..... 2
- Motion on Inclined Surface ..... 2
- Ballistic Pendulum ..... 2
- Newton's Second Law ..... 3
- Lami's Rule ..... 3
- Static Friction Coefficient ..... 3

## Electricity

- Measurement of Ohmic Resistances Using Ammeter and Voltmeter ..... 4
- Study the I-V Characteristics of Non-Ohmic Resistance ..... 4
- Kirchhoff's Loop Rule ..... 4
- RC Circuit (Charging Capacitor) ..... 5
- RC Circuit (Discharging Capacitor) ..... 5
- Variation of the Resistance of a Thermistor with Temperature Experiment ..... 5

## Magnetism

- Magnetic Moment of a Bar Magnet ..... 6
- Magnetic Field of a Circular Loop Current ..... 6

## Modern Physics

- Black Body Radiation ..... 7
- Optics Lab ..... 7
- Laser Beam Divergence ..... 7
- Laser Electro-Optic Effect ..... 8
- Millikan Oil Drop ..... 8
- Michelson Interferometer ..... 8
- I-V Characteristics of Solar Cell (I) ..... 9
- I-V Characteristics of Solar Cell (II) ..... 9
- I-V Characteristics of Solar Cell (III) ..... 9
- Zeeman Effect Experiment ..... 10



## Properties of Matter

- Determination of the Coefficient of Viscosity by Using Stokes Method ..... 11
- Young's Modulus for a Metallic Rod ..... 11
- Archimedes Principle ..... 11
- Density Measurement ..... 12

## Waves

- Focal Length of a Convex Lens Using General Law ..... 13
- Simple Pendulum ..... 13
- Hooke's Law ..... 13
- Speed of Sound Using Closed Columns ..... 14
- Speed of Sound Using Open Columns ..... 14

## General

- Safety Laboratory ..... 15



Properties of Matter

Magnetism

Waves

Modern Physics

Mechanics

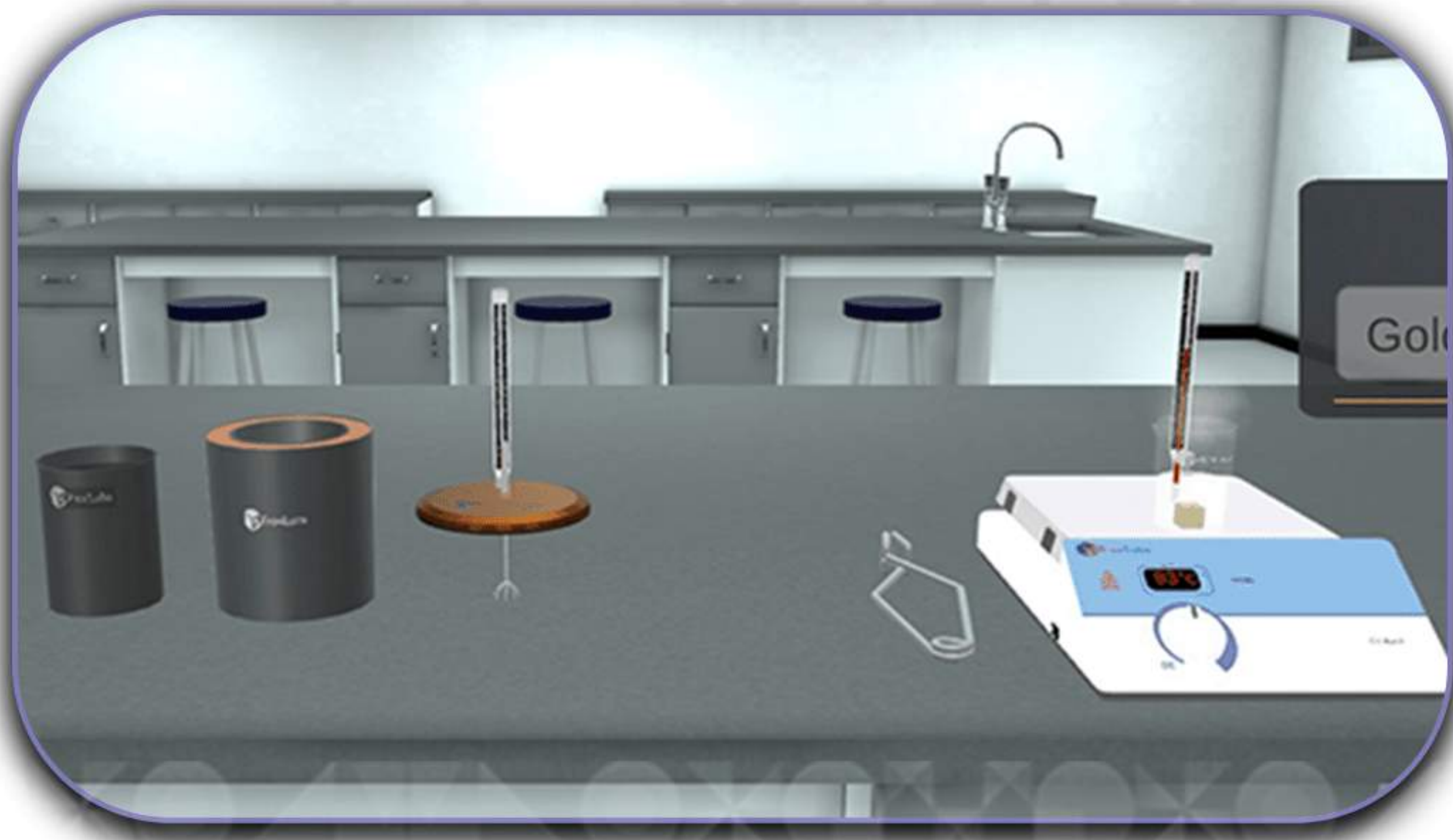
Electricity

Heat and Thermodynamics



# Heat and Thermodynamics

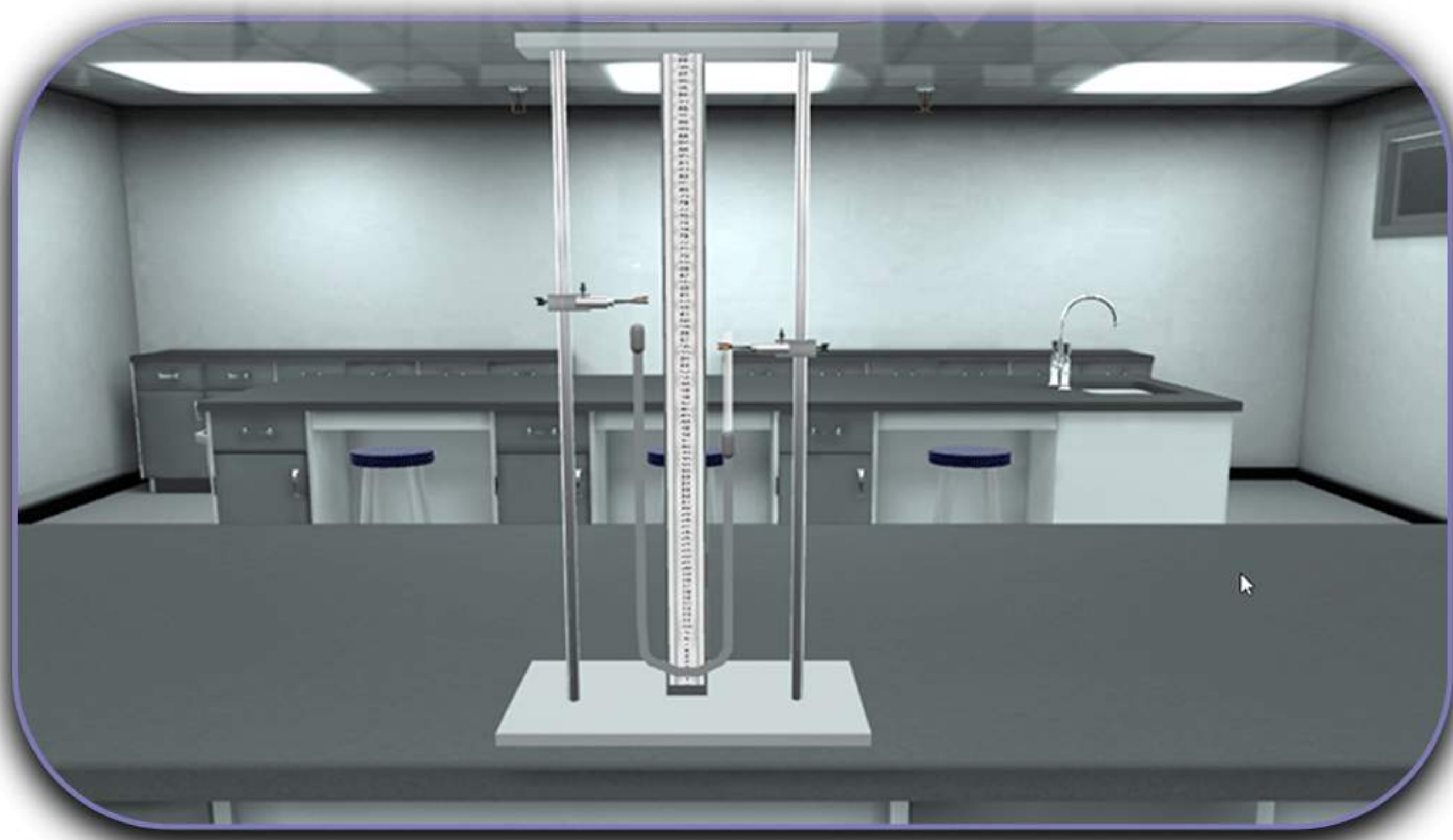
## Specific Heat of Solids



### Learning Objectives (ILOs)

- Define the specific heat capacity
- Set up an experiment to determine the specific heat capacities of three samples of different metals

## Boyle's Law of Gases



### Learning Objectives (ILOs)

- Explain the relation between the pressure exerted on an ideal gas and the volume it occupies at constant temperature
- Set up an experiment to study the pressure-volume relation for an ideal gas

## Joule's Experiment



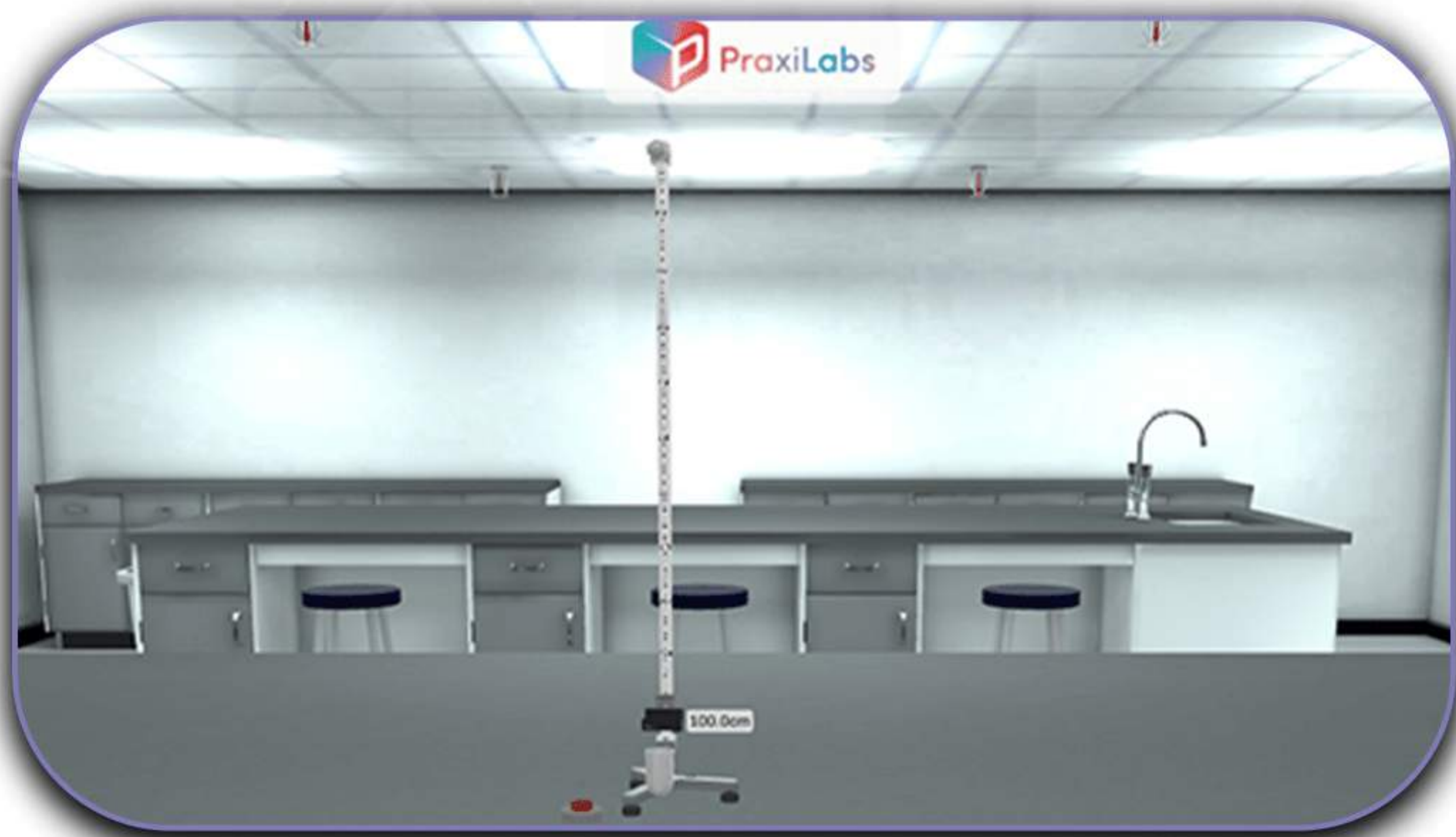
### Learning Objectives (ILOs)

- State the principle of conservation of energy
- Identify which types of energy were involved in the experiment
- Recognize how energy conversion takes place from electrical energy into heat energy
- Identify the different units used to measure energy
- Determine the value of the mechanical equivalent of heat and the coil resistance



# Mechanics

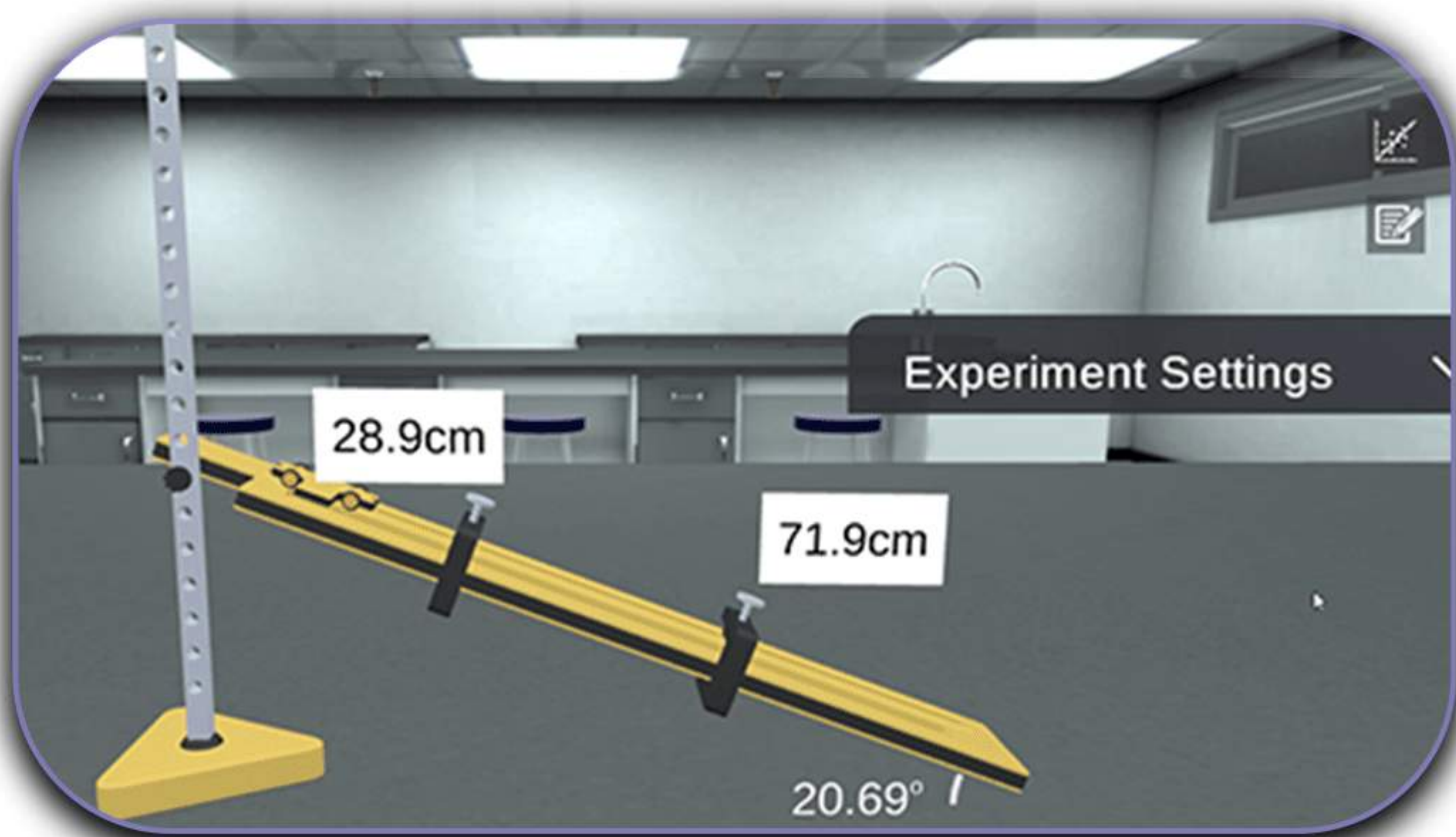
## Free Fall



### Learning Objectives (ILOs)

- Verify the equation of motion for an object under constant force
- Determine the free fall acceleration

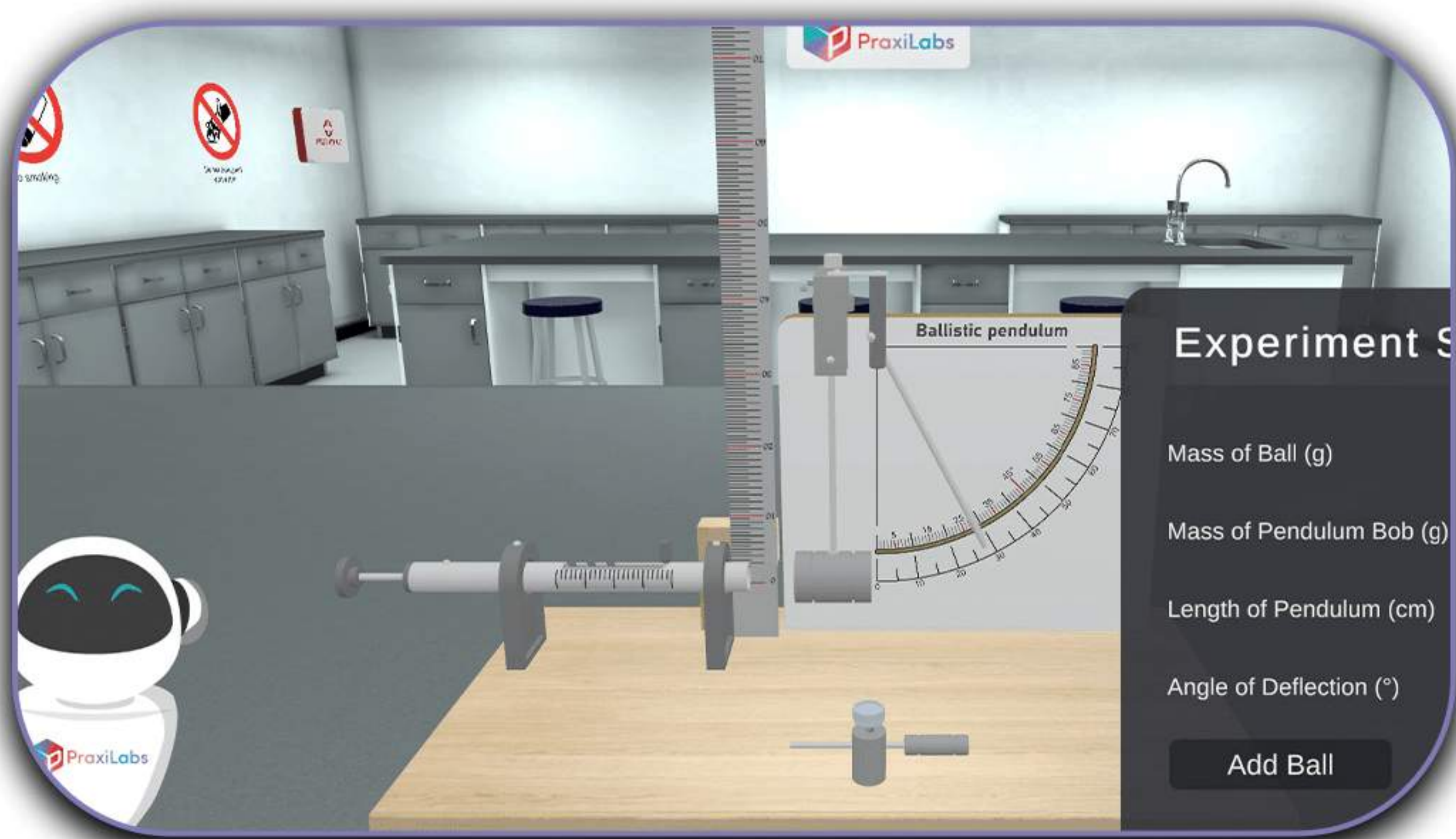
## Motion on Inclined Surface



### Learning Objectives (ILOs)

- Analyze the motion of a body on an inclined surface
- Determine the acceleration due to gravity

## Ballistic Pendulum



### Learning Objectives (ILOs)

- Understand the types of collisions
- Study the conservation of momentum and energy principals
- Calculate the initial velocity of the projectile ball in three ranges (short, medium, and long ranges)



## Learning Objectives (ILOs)



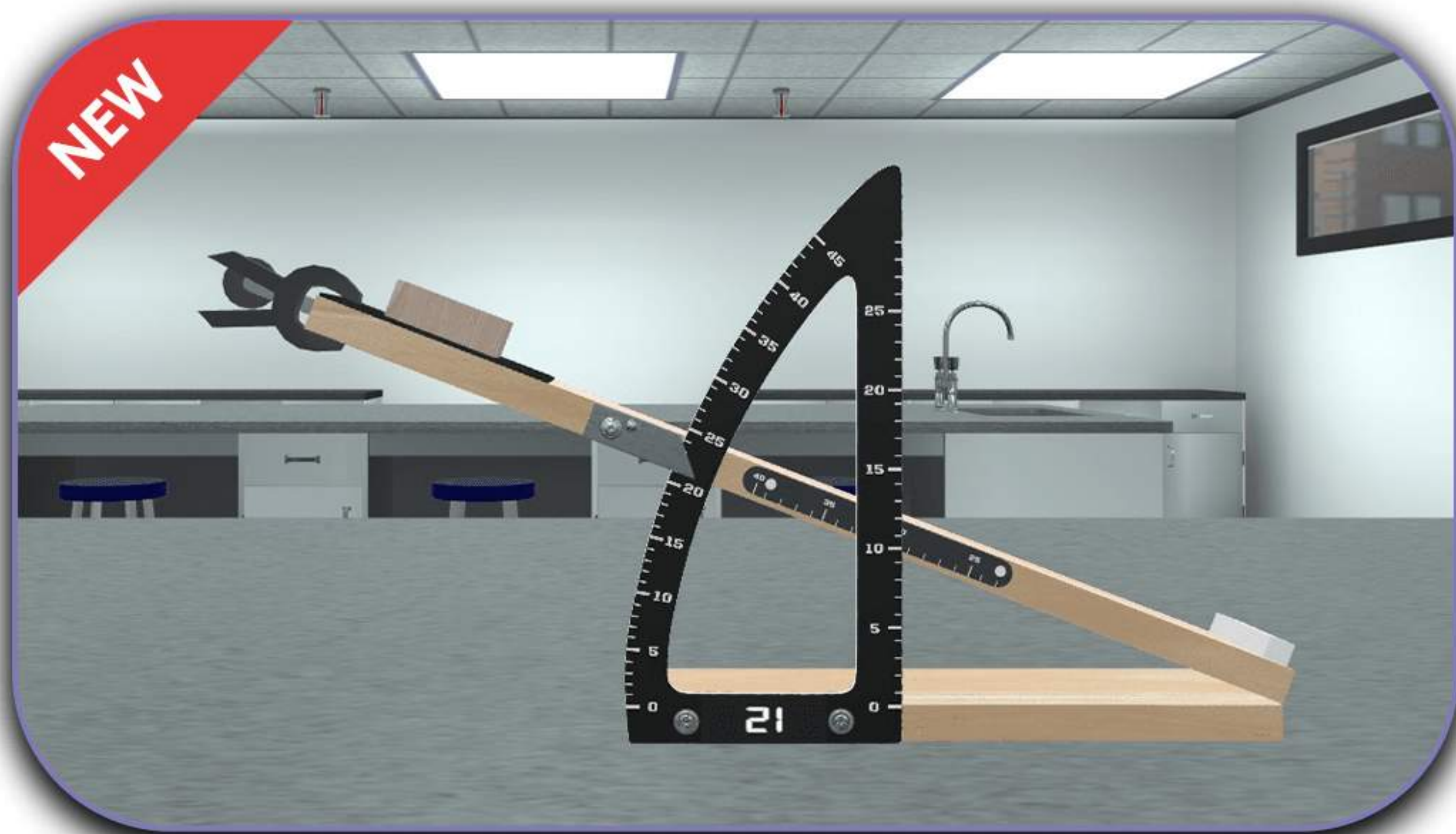
- To understand the meaning of net force and to use such an understanding to relate the values of individual forces to the value of the net force.
- To distinguish between the concepts of mass and weight and be able to perform calculations involving mass and weight.
- To state Newton's second law of motion, to express in equation form, and to use it to solve for acceleration, mass, or net force if knowledge of two of these three variables are known.
- To use free-body diagrams and the Newton's second law equation to determine the acceleration of an object.

## Learning Objectives (ILOs)



- Understand Lami's Rule.
- Apply Lami's Rule to find the unknown weight.
- Understand the relation between forces acting on a point at equilibrium and the angles between them.

## Learning Objectives (ILOs)



- Calculate the static friction coefficient for different types of surfaces.



# Electricity

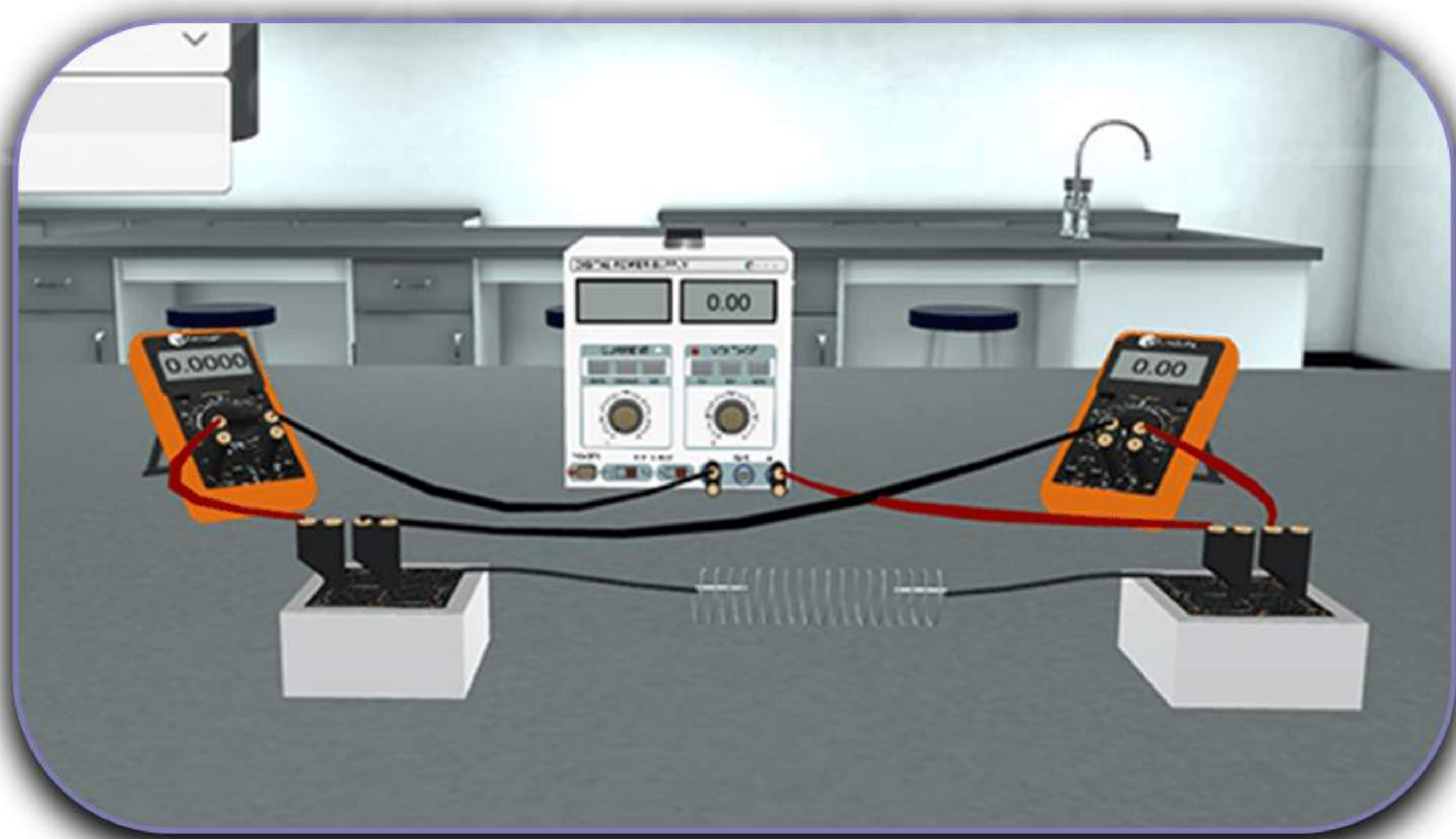
## Measurement of Ohmic Resistances Using Ammeter and Voltmeter



### Learning Objectives (ILOs)

- Understand the relation between current and voltage in a circuit with Ohmic resistance
- Set up an experiment to determine the equivalent resistance when many resistors are connected in series or in parallel

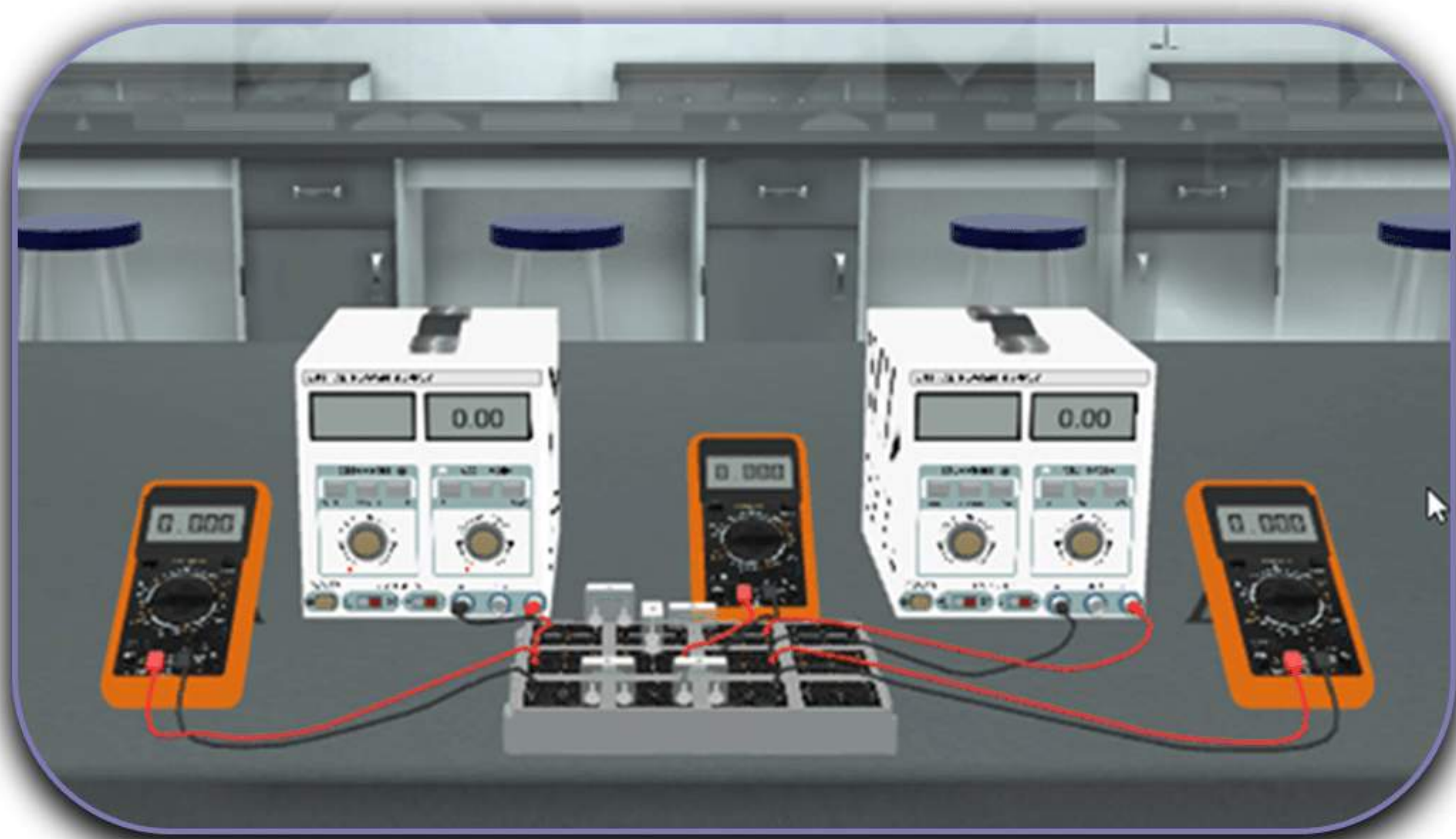
## Study the I-V Characteristics of Non-Ohmic Resistance



### Learning Objectives (ILOs)

- Understanding the difference between the non-Ohmic resistance and Ohmic resistance
- Set up an experiment to study the I-V characteristics of non-Ohmic resistors

## Kirchhoff's Loop Rule



### Learning Objectives (ILOs)

- State Kirchhoff's laws for electric circuits
- Apply Kirchhoff's current law at node (or junction) points in an electric circuit
- Apply Kirchhoff's voltage law around closed loops within electric circuits
- Deduce the value of the current in different branches of an electric circuit



## RC Circuit (Charging Capacitor)



### Learning Objectives (ILOs)

- See the benefits of using the capacitor and understand what is the capacitance of the capacitor
- Understand that the variation of charging voltage with time depends on the capacitance and resistance
- Calculate capacitor's capacitance and the time constant

## RC Circuit (Discharging Capacitor)



### Learning Objectives (ILOs)

- See the benefits of using the capacitor and what is the capacitance of the capacitor
- Study the variation of discharge voltage with time and this depends on capacitance and resistance
- Calculate the capacitor's capacitance and time constant

## Variation of the Resistance of a Thermistor with Temperature Experiment

New



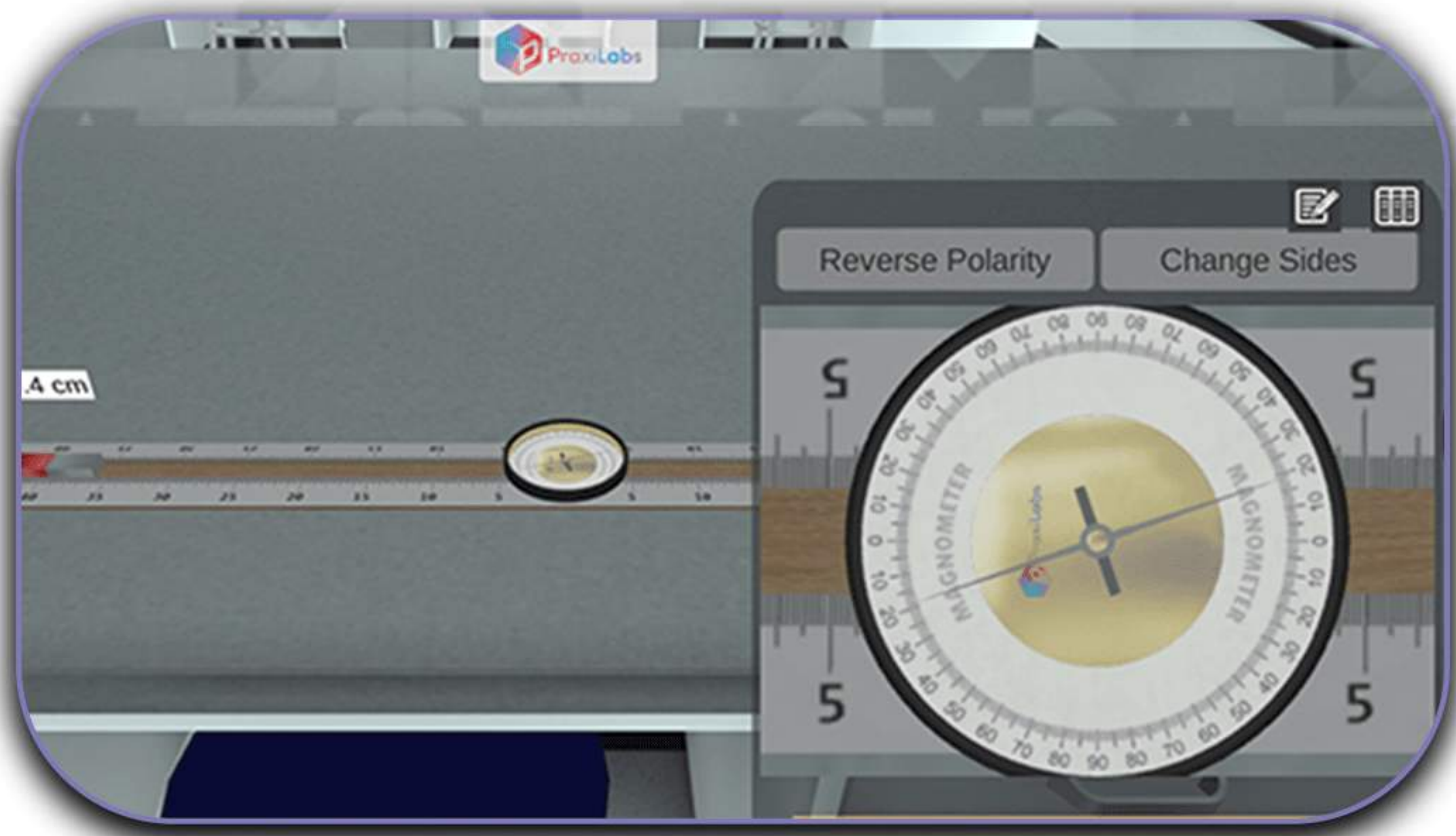
### Learning Objectives (ILOs)

- Differentiate between the NTC and PTC type thermistor.
- Learn how the resistance of the thermistor changes with temperature.
- Determine the value of activation energy ( band gap energy ) of thermistor material.



# Magnetism

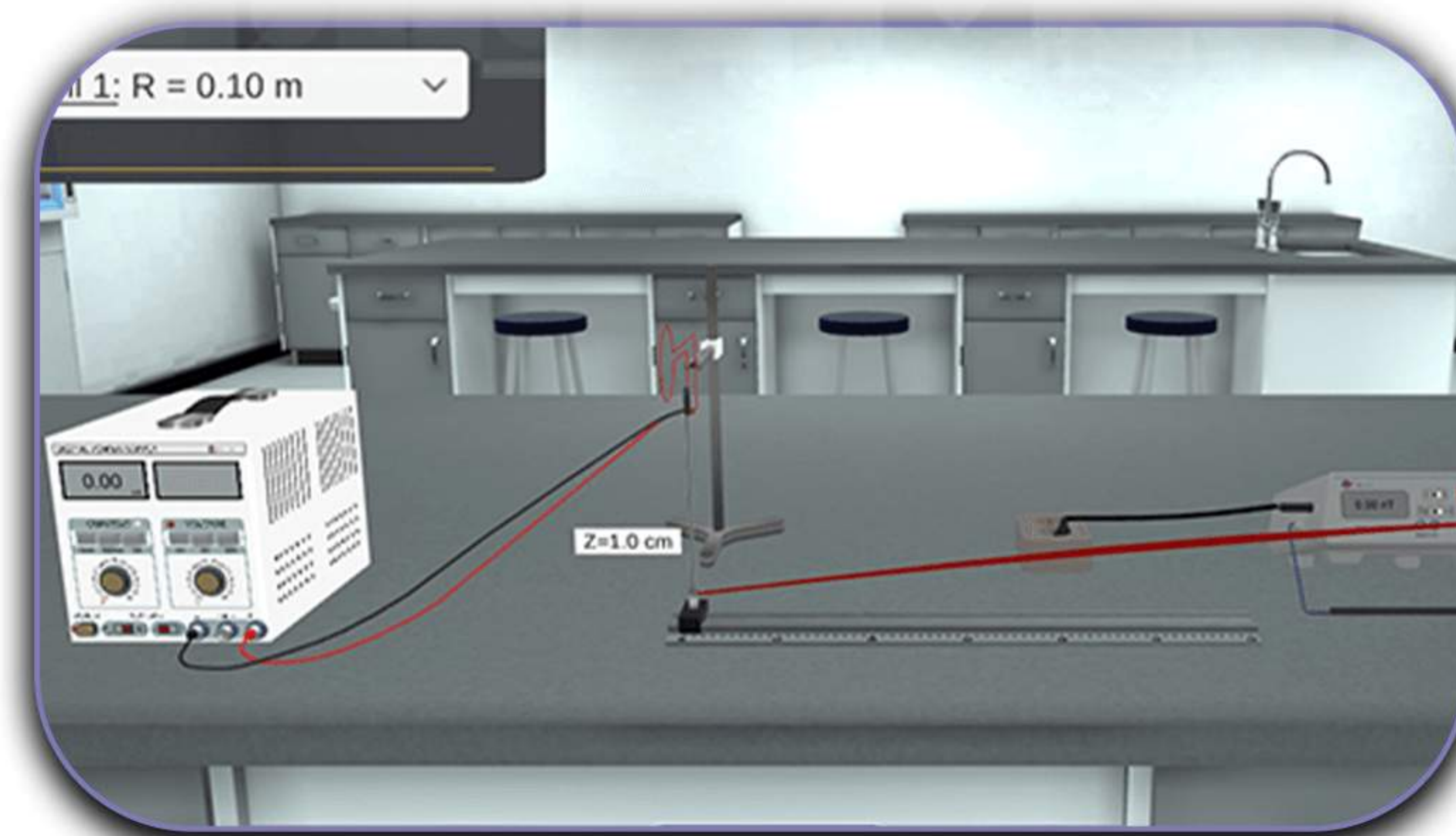
## Magnetic Moment of a Bar Magnet



### Learning Objectives (ILOs)

- Explain the operation of the tangent galvanometer
- Set up an experiment to study the magnetic properties of a bar magnet
- Determine the value of the pole strength of a bar magnet

## Magnetic Field of a Circular Loop Current



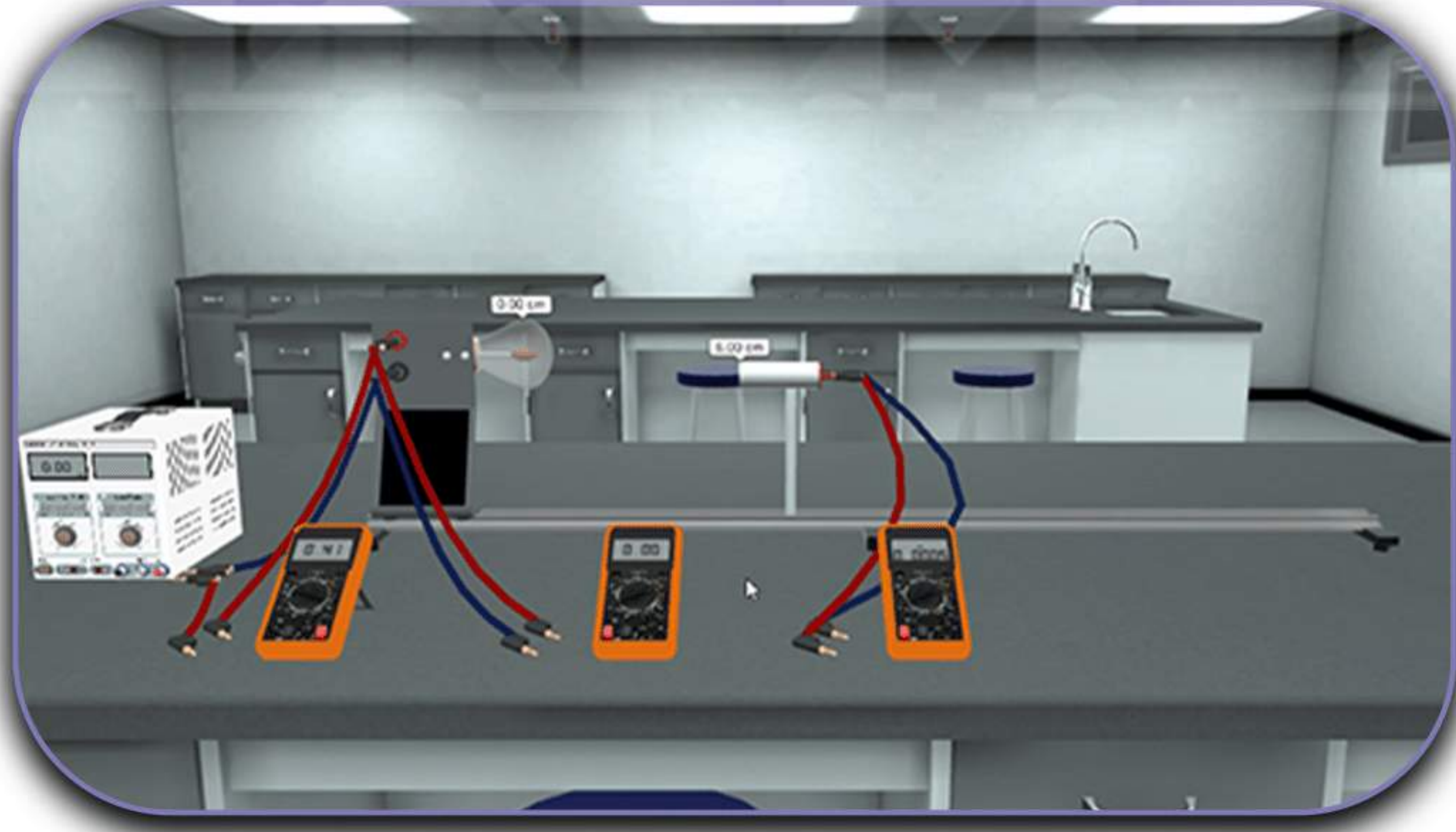
### Learning Objectives (ILOs)

- Enumerate the factors affecting the magnetic field due to circular loop carrying current
- Set up an experiment to study the magnetic field produced by current passing through a circular loop along its axis



# Modern Physics

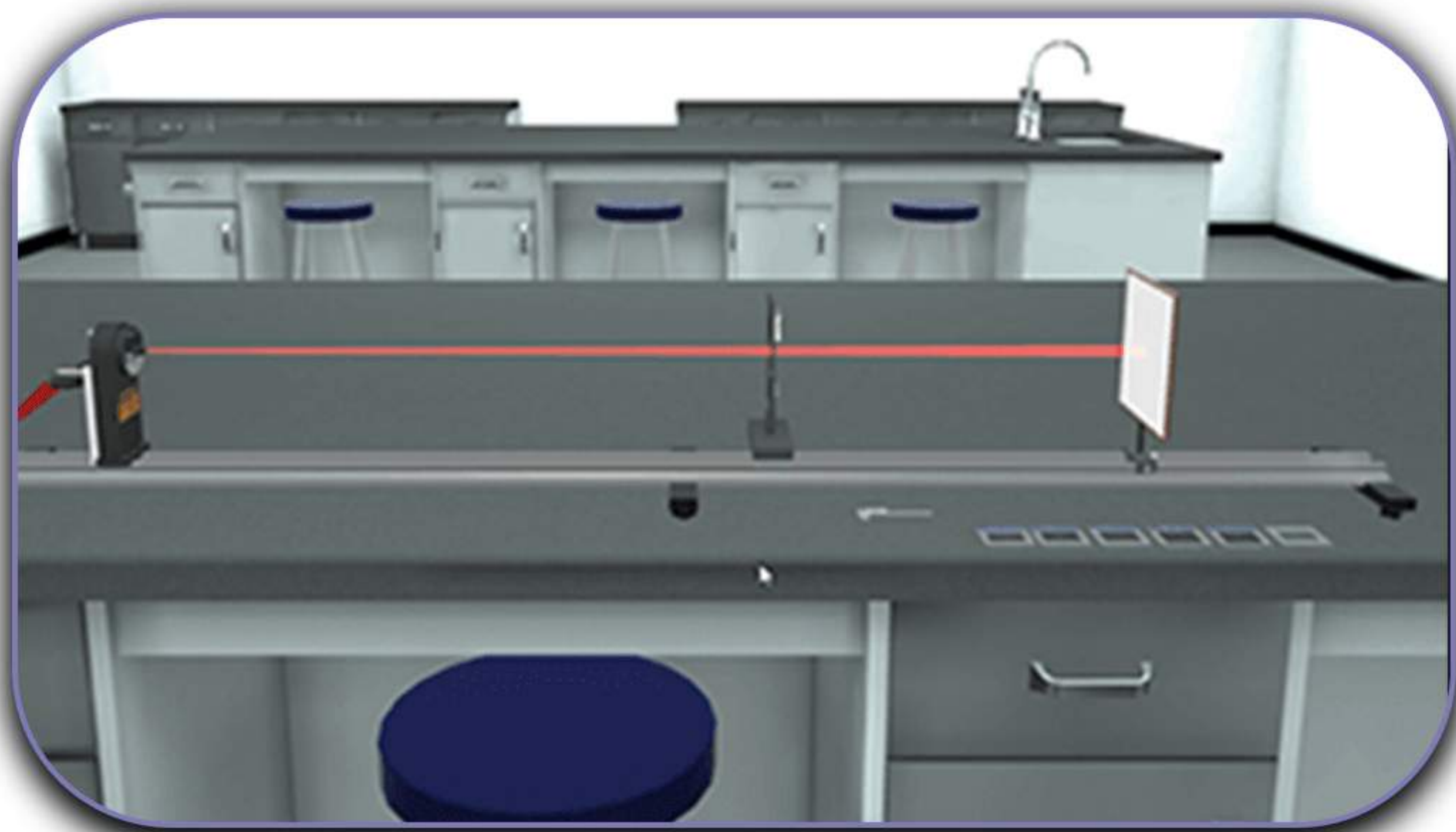
## Black Body Radiation



### Learning Objectives (ILOs)

- Verify the fourth law of radiation
- Generate Planck's curves for Stefan Boltzmann lamp at different temperatures and verify Wien's law
- Verify the inverse square law for electromagnetic (EM) radiation

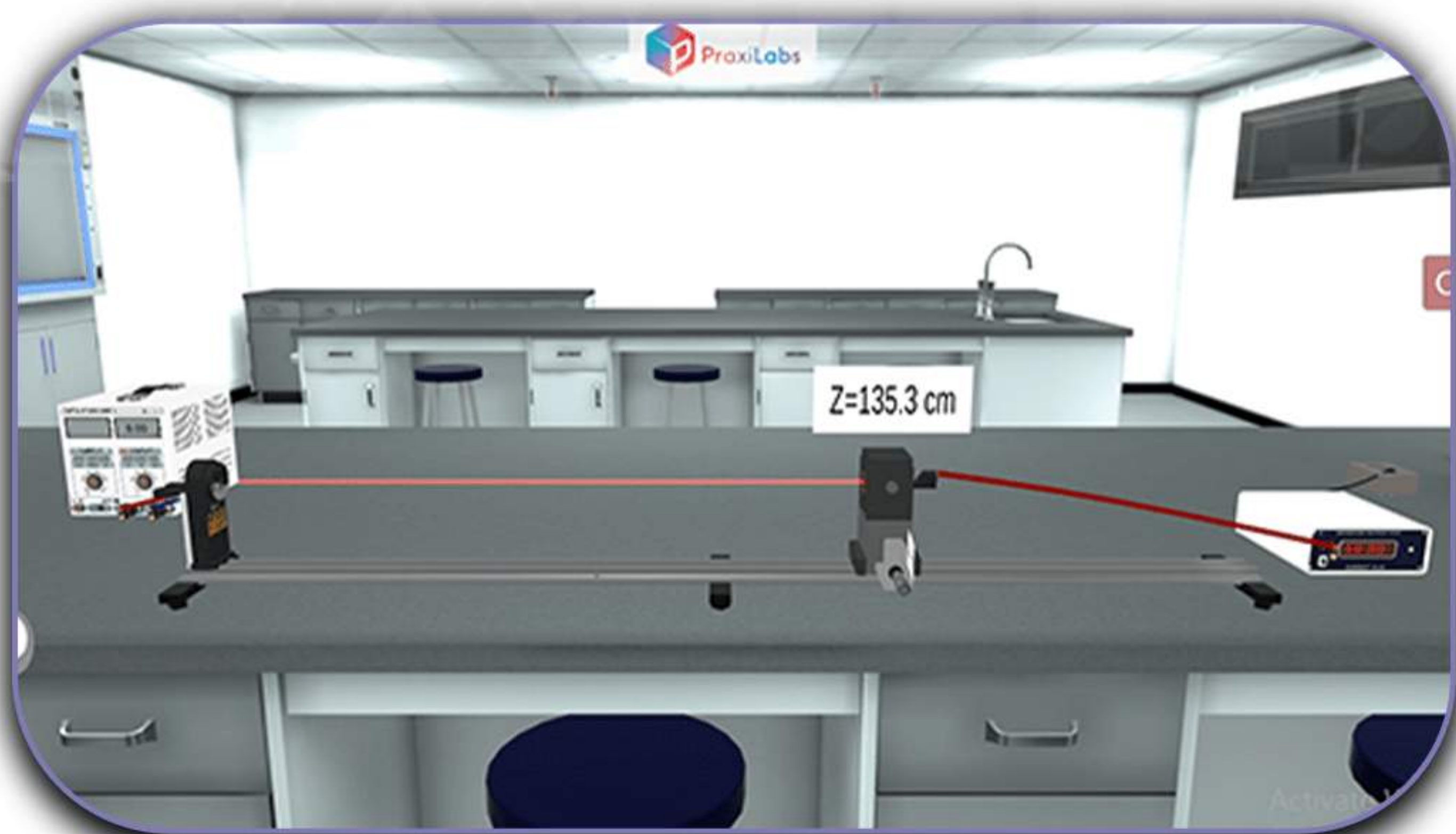
## Optics Lab



### Learning Objectives (ILOs)

- Set up an experiment to study the interference and diffraction phenomena for monochromatic light
- Explain the resulting interference and diffraction spectra
- Use the experiment to determine the width of a human hair

## Laser Beam Divergence



### Learning Objectives (ILOs)

- Define the profile of a laser beam
- Set up an experiment to study the laser beam profile
- Determine the laser beams' diameter
- Prove that the laser does not obey the inverse square law



## Laser Electro-Optic Effect



### Learning Objectives (ILOs)

- Explain the electro-optic effect in a Lithium Niobate crystal
- Set up an experiment to study the electro-optic effect in crystals
- Determine the half-voltage value of electro-optic crystals

## Millikan Oil Drop



### Learning Objectives (ILOs)

- Explain the effect of the electric field on the motion of charged particles within it
- Analyze the motion of charged oil drop within an electric field in terms of the different factors affecting its motion
- Demonstrate that electric charge only comes in discrete units – “the quantization of charge”
- Measure the intrinsic charge of the electron (the smallest discrete unit of charge)

## Michelson Interferometer



### Learning Objectives (ILOs)

- Construct the Michelson interferometer
- Recognize the function of each component in the interferometer
- Understand the operation of the interferometer
- Interpret the observed in the interference pattern



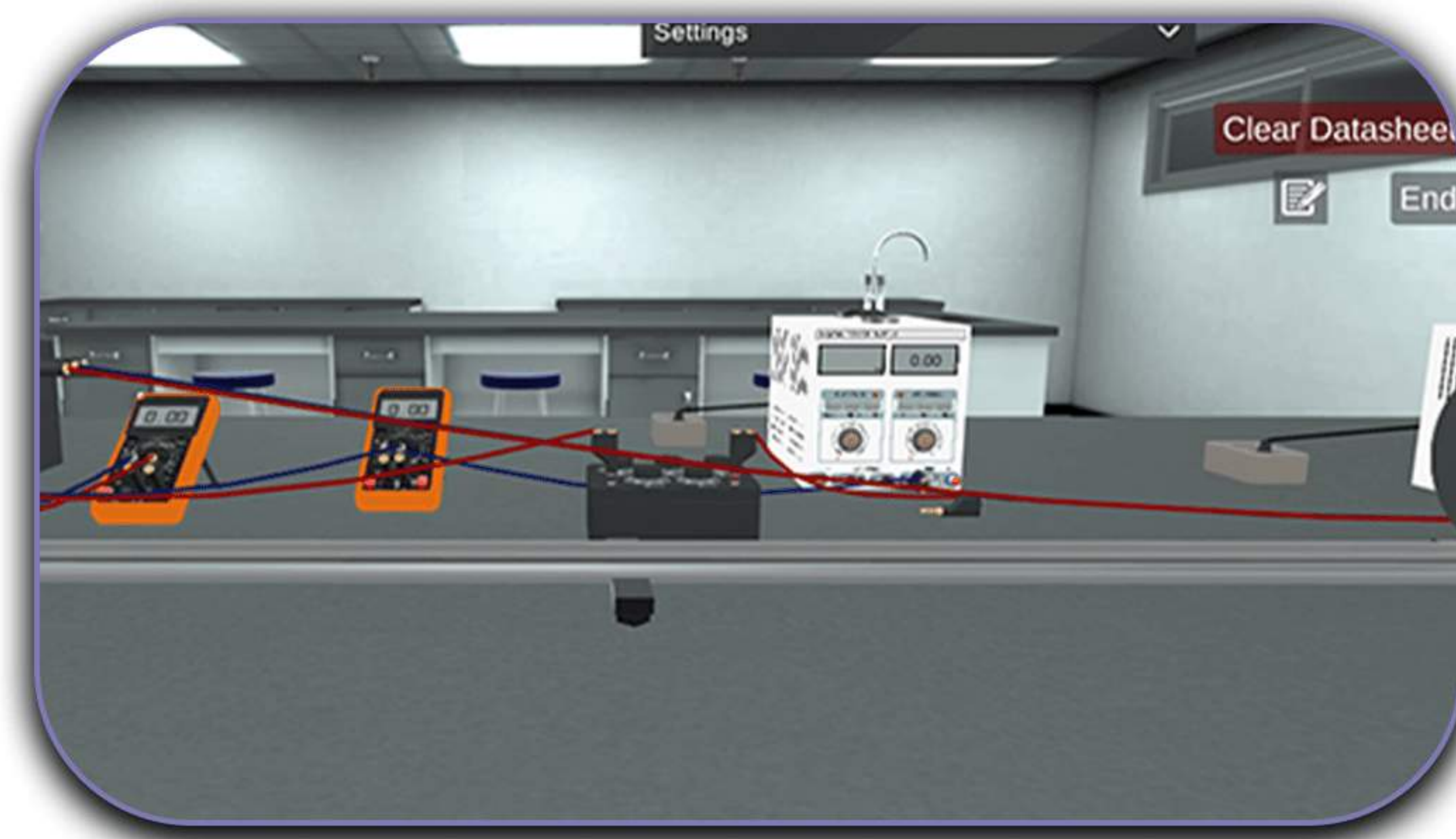
## I-V Characteristics of Solar Cell (I)



### Learning Objectives (ILOs)

- Describe the construction and operation of the PV cell
- Enumerate the different factors that may affect the operation of the PV cell
- Analyze the equivalent circuit of the PV cell and its parameters

## I-V Characteristics of Solar Cell (II)



### Learning Objectives (ILOs)

- Describe the construction and operation of the PV cell
- Enumerate the different factors that may affect the operation of the PV cell

## I-V Characteristics of Solar Cell (III)



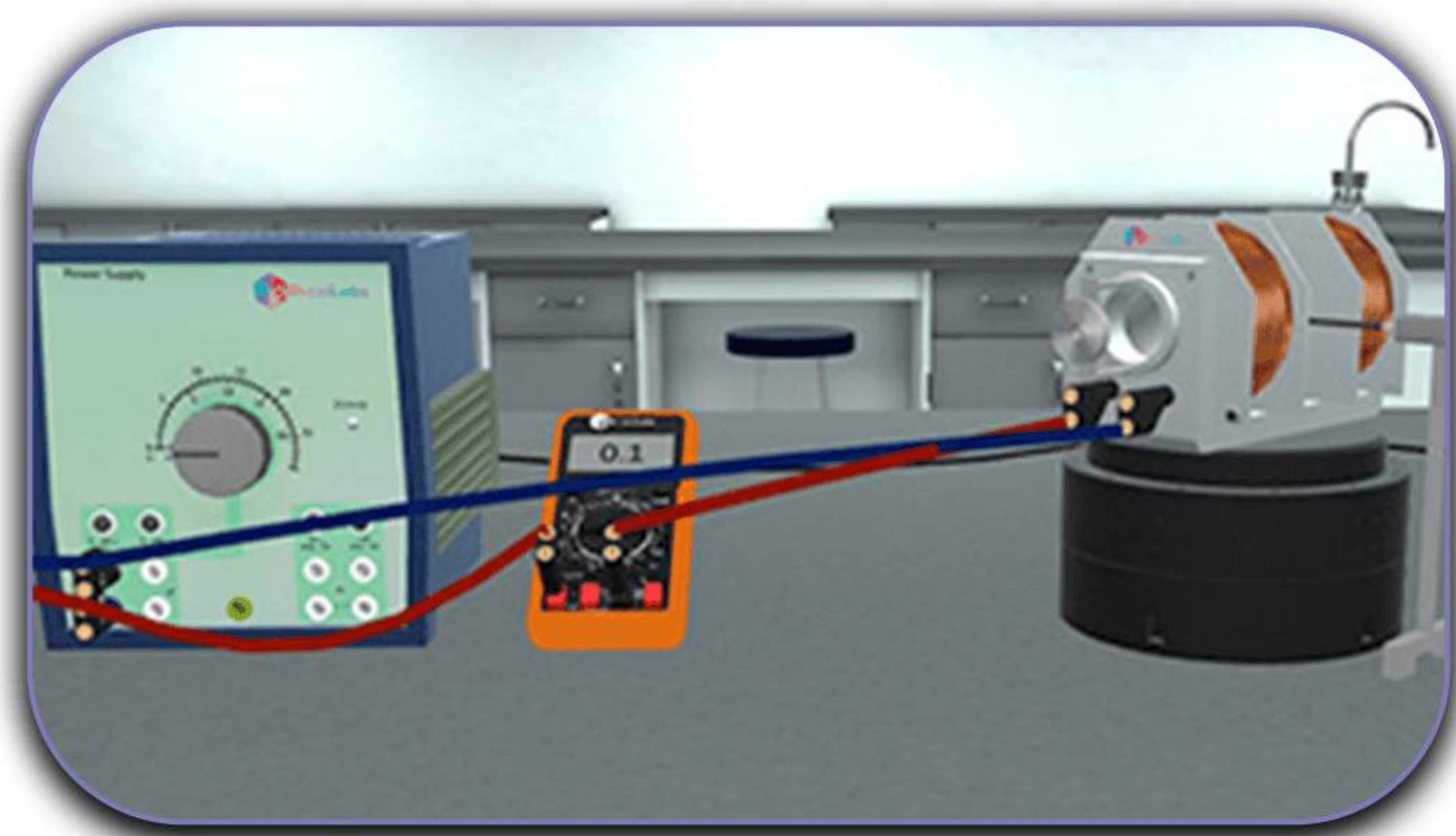
### Learning Objectives (ILOs)

- Describe the construction and operation of the PV cell
- Enumerate the different factors that may affect the operation of the PV cell



# Zeeman Effect Experiment

## Learning Objectives (ILOs)



- Observe the Zeeman triplet and doublet splitting of the characteristic red line (643.8 nm) in transverse and longitudinal configurations, respectively
- Understand the operation of the Fabry-Perot interferometer (etalon)
- Set up an experiment to study the normal Zeeman effect in Cadmium (as an example of singlet systems (Total Spin Momentum = 0))
- Determine the polarization state of the triplet and doublet components



# Properties of Matter

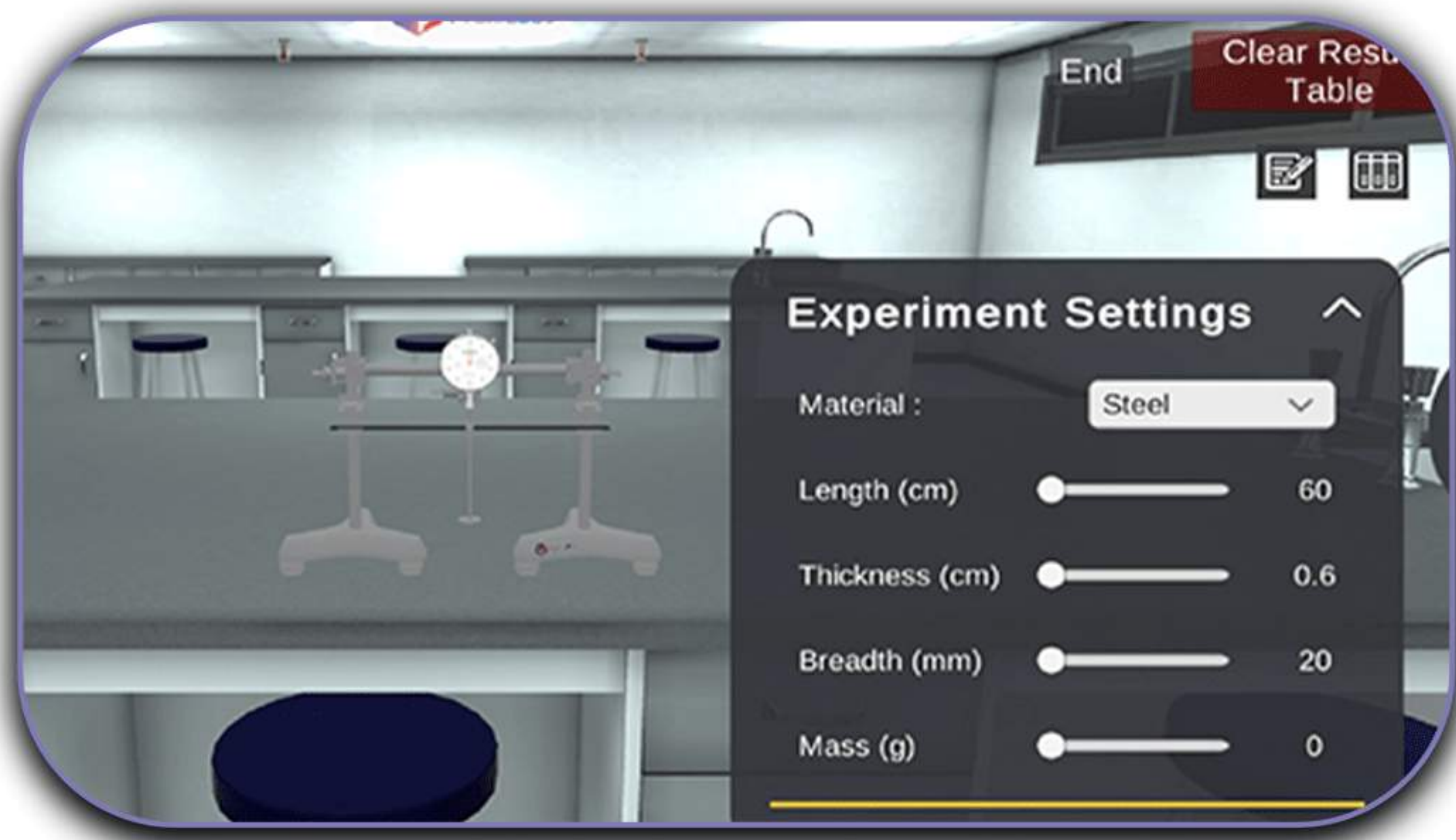
## Determination of the Coefficient of Viscosity by Using Stokes Method



### Learning Objectives (ILOs)

- Employ Stokes Method to find the terminal velocity of an object in a viscous medium
- Enumerates the different factors that could alter the viscosity of a liquid

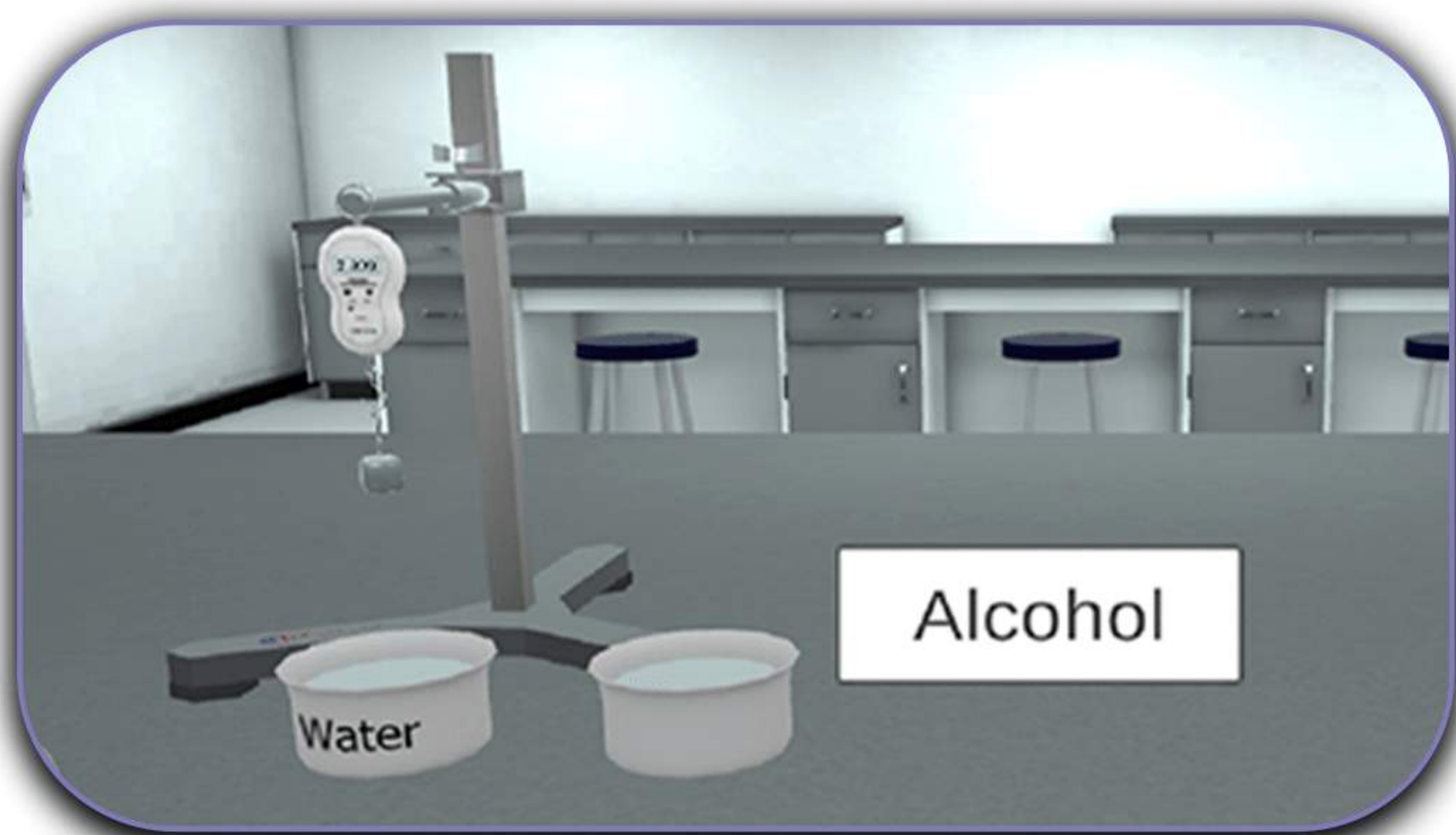
## Young's Modulus for a Metallic Rod



### Learning Objectives (ILOs)

- Understand the relation between stress and strain
- Predict the behavior of material undergoing elastic deformation
- Determine the value of Young's modulus of elasticity

## Archimedes Principle



### Learning Objectives (ILOs)

- Understanding the concept of Archimedes principle and the physics behind buoyancy force
- Set up an experiment to determine the specific gravity of a solid or a liquid. Hence, the material can be identified





## Learning Objectives (ILOs)

- Define the density of a material
- Understand that the density is a property of the material
- Identify the type of material from the density measurement
- Prepare a suitable experimental setup to determine the density of a material in the form of a regular solid, irregular solid, and liquids



# Waves

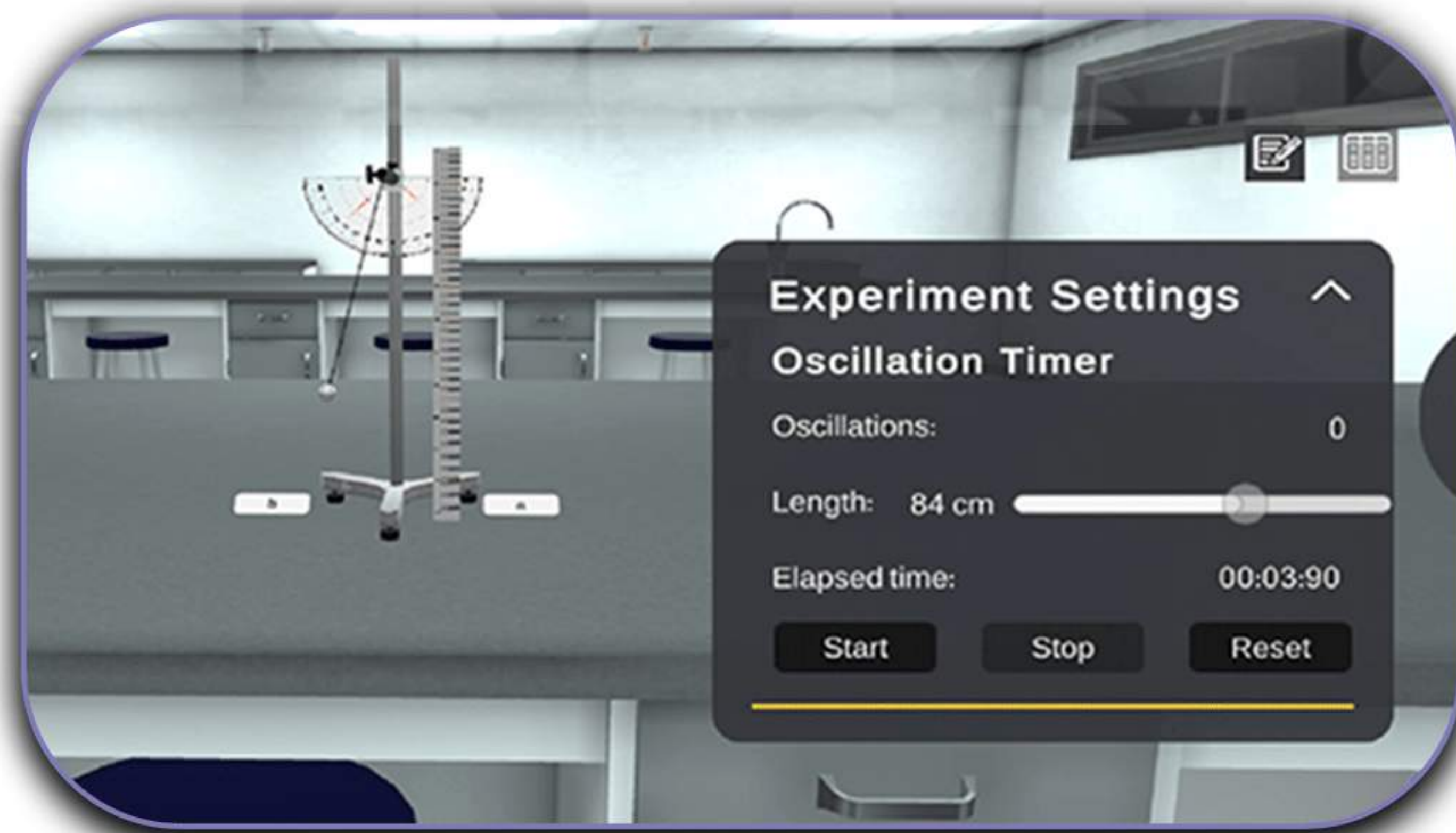
## Focal Length of a Convex Lens Using General Law



### Learning Objectives (ILOs)

- Understand the image formation for a convex lens
- Understanding the difference between both the focal length and power of a lens and how to determine them

## Simple Pendulum



### Learning Objectives (ILOs)

- Understand the motion of a simple pendulum under small angle approximation
- Introduce the simple harmonic motion as an example for periodic motion
- Understand the source of experimental error for a real pendulum

## Hooke's Law

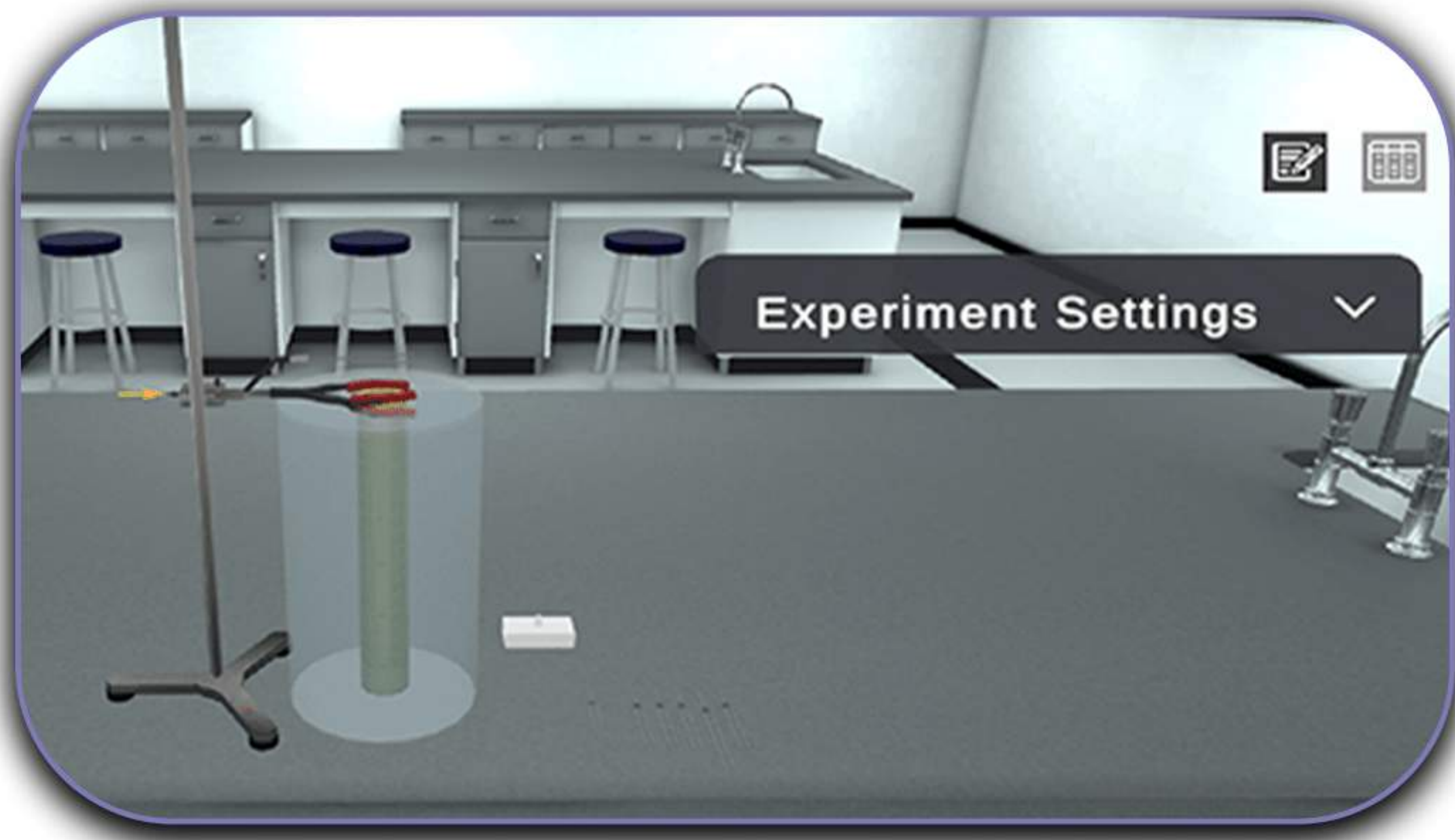


### Learning Objectives (ILOs)

- State Hooke's law
- Enumerate the factors affecting the spring constant
- Set up an experiment to determine the spring constant using static and dynamic methods



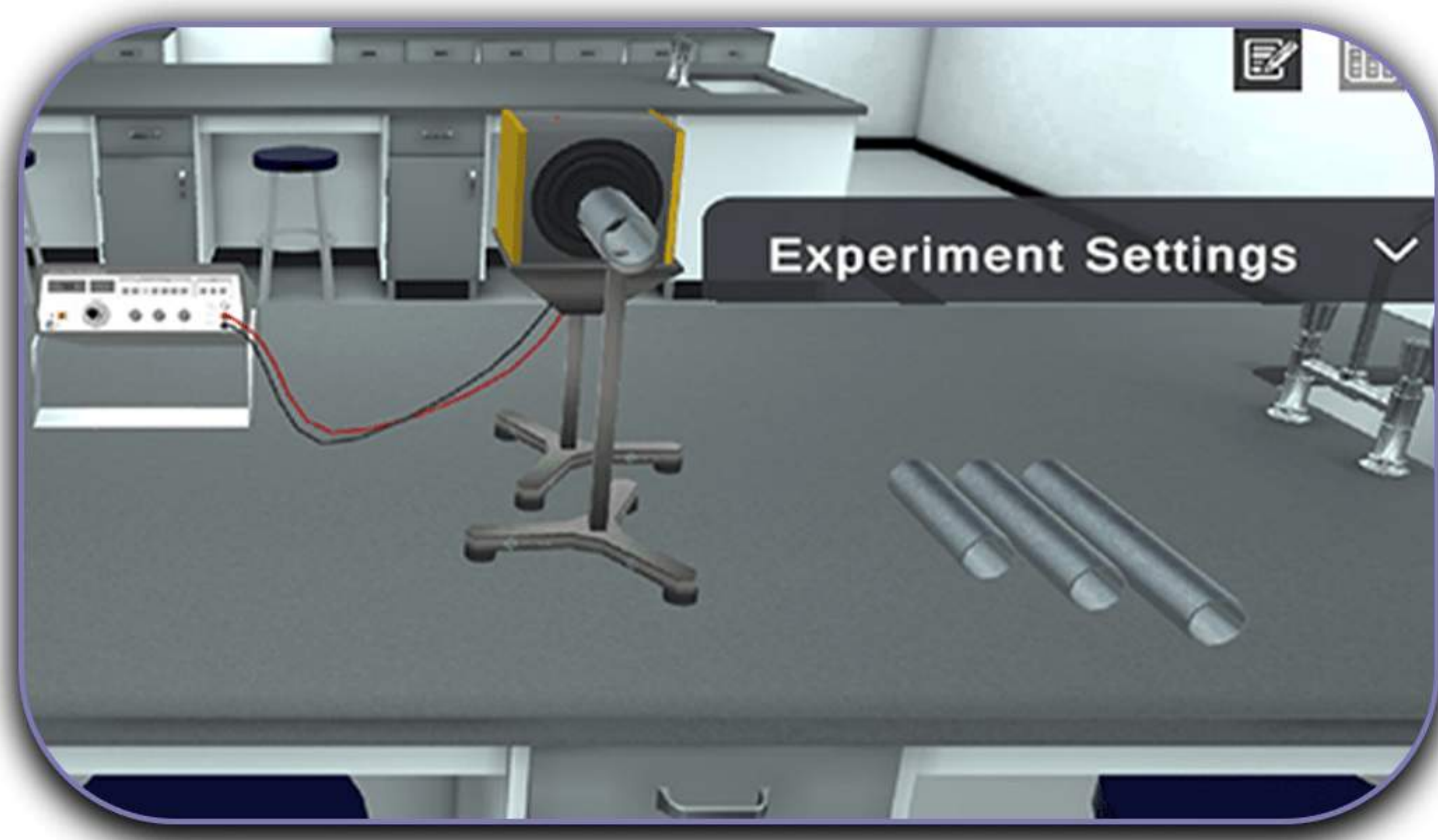
## Speed of Sound Using Closed Columns



### Learning Objectives (ILOs)

- Differentiate between types of waves
- Explain how standing waves can be generated in closed air columns
- Explain the occurrence of resonance phenomena in closed-air columns

## Speed of Sound Using Open Columns



### Learning Objectives (ILOs)

- Explain the resonance phenomena in an open air column
- Set up an experiment to determine the speed of sound in air using an open air column



## Safety Laboratory

### Learning Objectives (ILOs)



- Identify different safety signs
- Distinguish between different types of signs
- Practice a real experiment applying safety measures
- Anticipate right and wrong actions in a science lab
- Examine material safety data sheet
- Decide what to do if small accidents could happen