



# SCI102: Physical Science

Students explore the relationship between matter and energy by investigating force and motion, the structure of atoms, the structure and properties of matter, chemical reactions, and the interactions of energy and matter. Students develop skill in measuring, solving problems, using laboratory apparatuses, following safety procedures, and adhering to experimental procedures. Students focus on inquiry-based learning, with hands-on laboratory investigations making up half of the learning experience.

**COURSE LENGTH:** Two semesters

**MATERIALS:** *Physical Science: A Laboratory Guide*; materials for laboratory experiments

**PREREQUISITES:** K<sup>12</sup> middle school Physical Science, or equivalent

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## SEMESTER ONE

### Unit 1: Matter and Energy

In this unit, students learn about the depth of physical science, the relationship between matter and energy, and scientific methods. Students use scientific methods in a laboratory setting and demonstrate their results through graphing.

- Semester Introduction
- Dimensions: Distance, Time, and Mass
- Matter, Energy, and the Scientific Method
- Creating and Analyzing Graphs
- Laboratory: Drop and Bounce 1
- Laboratory: Drop and Bounce 2

### Unit 2: Forces and Motion

In this unit, students study Newton's three laws of motion, and they demonstrate those laws in a hands-on laboratory and in online simulations. Students also learn to define *acceleration* and *force*.

- Describing and Measuring Motion
- Acceleration
- Forces
- Laboratory: Drop and Bounce Revisited
- Newton's First Law of Motion
- Newton's Second Law of Motion
- Newton's Third Law of Motion
- Laboratory: Mass in Motion 1
- Laboratory: Mass in Motion 2

### Unit 3: Application of Forces

Students explore friction, gravity, and force in this unit. They begin to understand the concept of vectors and learn to describe force in terms of vectors.

- Friction
- Gravity
- Gravity and Motion
- Forces and Vectors



- Laboratory: Net Force 1
- Laboratory: Net Force 2

#### **Unit 4: Fluid Forces**

An understanding of fluid forces is important to the study of physical science. In this unit, students observe and graph how shape influences movement through a fluid. They learn to define density and understand its relationship to buoyancy. Students relate the concept of pressure to buoyancy. Students learn to describe Pascal's and Bernoulli's principles.

- Pressure
- Buoyancy
- Laboratory: Density and Buoyancy 1
- Laboratory: Density and Buoyancy 2
- Pascal's Principle
- Bernoulli's Principle
- Laboratory: Shapes and Fluid Forces 1
- Laboratory: Shapes and Fluid Forces 2

#### **Unit 5: Energy**

Energy has a profound effect on our physical environment. In this unit, students first develop a firm basis for understanding changes in energy and identifying potential and kinetic energy. Designing a thermos in a laboratory provides the basis for the development of students' understanding of how heat moves. As in other units, students' understanding of facts stems from their mastery of the big ideas of physical science.

- Energy
- Energy Change
- Potential and Kinetic Energy
- Laboratory: Pendulum 1
- Laboratory: Pendulum 2
- Laboratory: Elasticity 1
- Laboratory: Elasticity 2
- Heat Energy
- How Energy Moves
- Laboratory: Heat Transfer 1
- Laboratory: Heat Transfer 2
- Laboratory: Design a Thermos 1
- Laboratory: Design a Thermos 2

#### **Unit 6: Work**

Work and the ability to do work are the focus of this unit. Students explore the properties of a simple machine. They learn the factors that influence force. In their exploration, they also determine the effect of pulleys and levers—two simple machines.

- Work
- Simple Machines and Mechanical Advantage
- Power
- Laboratory: Levers 1
- Laboratory: Levers 2
- Laboratory: Pulleys 1
- Laboratory: Pulleys 2



### Unit 7: Waves

The properties of waves and the effects of waves on physical systems are the focus of this unit. Students explore the different kinds of waves, and they learn the factors that influence waves. Students learn to define *frequency*, *wavelength*, and *pitch*. Finally, students learn to demonstrate and explain the Doppler effect.

- Introduction to Waves
- Properties of Waves
- Wave Energy
- Transverse and Longitudinal Waves
- Laboratory: Waves 1
- Laboratory: Waves 2
- Sound
- Frequency, Wavelength, and Pitch
- Laboratory: Doppler Effect 1
- Laboratory: Doppler Effect 2

### Unit 8: Light

In this unit, students thoroughly explore the concept of light. They study the speed of light and how it is determined, the properties of the electromagnetic spectrum, and color. They learn to define *reflection and refraction*, and describe their characteristics.

- Light
- Speed of Light
- Reflection and Refraction
- Electromagnetic Spectrum
- Color

### Unit 9: Electricity

Electricity and magnetism are the focus of this unit. Students explore electricity and magnetism as they build an electric motor. They learn the components that make up circuits.

- Electricity and Magnetism
- Laboratory: Electric Motor 1
- Laboratory: Electric Motor 2
- Circuits

### Unit 10: Semester Review and Test

- Semester Review
- Semester Test

## SEMESTER TWO

### Unit 1: Nature of Matter

The difference between matter and energy is the focus of this unit. Students examine the classification of matter, the nature of energy, and viscosity. In their laboratory, they demonstrate knowledge of these concepts through observation and data reporting.

- Semester Introduction
- Nature of Matter
- Classification of Matter
- Matter and Energy
- Laboratory: Viscosity 1
- Laboratory: Viscosity 2

### Unit 2: States of Matter

Phase changes are a tangible way to understand the states of matter. In this unit, students observe phase changes. In their observation, they examine the properties of heat and energy. By the end of this unit, students have a solid knowledge of thermodynamics.

- States of Matter
- Matter Changes State
- Kinetic Theory of Matter
- Laboratory: Evaporation 1
- Laboratory: Evaporation 2
- Laboratory: Phase Change 1
- Laboratory: Phase Change 2
- Laws of Thermodynamics
- Heat Energy and Matter
- Laboratory: Endothermic Process 1
- Laboratory: Endothermic Process 2

### Unit 3: Gas Laws

The environment is made up of gases. Students examine the laws that govern gases, paying particular attention to the effects of pressure, temperature, and volume. The gas laws are demonstrated in the laboratory.

- Gases
- Pressure, Temperature, and Volume
- Introduction to the Gas Laws
- Laboratory: Gas Laws 1
- Laboratory: Gas Laws 2

### Unit 4: Atoms

Students gain a firm basis for understanding the atom and its characteristics. Students look at the atom in greater detail, including the atomic model, atomic number, atomic mass, and atomic nucleus. Building on the big ideas of the atom, students develop a strong central basis for understanding radioactive dating, fusion, and fission.

- Atoms
- Atomic Model
- Atomic Number

- Atomic Mass
- Nucleus of the Atom
- Radioactivity
- Radioactive Dating
- Fusion and Fission

### Unit 5: Elements

Students explore the properties of elements and the placement of elements in the periodic table. They begin to understand why an element is placed where it is in the table and draw conclusions about that element based on its location. They demonstrate an understanding of metals and nonmetals and the nature of compounds.

- Elements
- Periodic Table 1
- Periodic Table 2
- Properties of Metals and Nonmetals
- Elements and Compounds

### Unit 6: Mixtures

Students learn to identify mixtures and solutions, and differentiate between certain kinds of solutions. They demonstrate a working knowledge of solubility in their laboratory.

- Introduction to Mixtures
- Introductions to Solutions
- Laboratory: Mixtures 1
- Laboratory: Mixtures 2
- Laboratory: Solubility 1
- Laboratory: Solubility 2
- Factors That Influence Solubility

### Unit 7: Bonds

The focus of this unit is bonding: the configuration of electrons and different kinds of bonds. Understanding bonding is essential to a study of physical science. In addition to giving students a firm understanding of bonding, this unit prepares students for understanding what happens in chemical reactions.

- Electron Configurations
- Valence Electrons
- Ionic Bonds
- Covalent Bonds
- Polar Covalent Bonds and Electronegativity
- Hydrogen Bonding and Metallic Bonding

### Unit 8: Chemical Reactions

The focus of this unit is an understanding of chemical reactions. Students observe chemical reactions and draw conclusions about what happened in those reactions. They apply their knowledge of bonding as they balance chemical equations. Students also explore solutions chemistry.

- Introduction to Chemical Reactions
- Laboratory: Chemical Reactions 1





- Laboratory: Chemical Reactions 2
- Laboratory: Copper-Plating Solution 1
- Laboratory: Copper-Plating Solution 2
- Chemical Reactions Explained
- How to Balance a Chemical Equation
- Solution Chemistry

### **Unit 9: Acids and Bases**

In this unit, students focus on acid and base reactions. They start out learning the definition of acid and base. They learn to explain and use the pH scale and describe the properties of acids and bases. Students observe acid–base reactions and learn the importance of buffers.

- Acids
- Bases
- pH Scale
- Acid and Base Reaction
- Buffers
- Laboratory: Acid Neutralization 1
- Laboratory: Acid Neutralization 2

### **Unit 10: Organic Chemistry**

Students explore the field of organic chemistry through a thorough exploration of the four macromolecules: proteins, carbohydrates, lipids, and nucleic acids. They study the functional groups that make up those compounds.

- Organic Chemistry
- Functional Groups
- Macromolecules

### **Unit 11: Semester Review and Test**

- Semester Review
- Semester Test