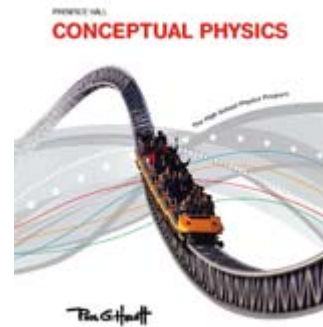


# Physics

## 10th – 12th Grade Text

### Course Description

**This course introduces students to the fundamental principles of physics. Each lesson provides comprehensive coverage of a specific concept or topic. Some of the concepts and laws of physics covered include mechanics, properties of matter, heat, sound and light, electricity and magnetism, atomic and nuclear physics. Students study the thoughts and contributions of some of the greatest minds in physics, including Newton, Einstein, Kepler and Bernouli.**



### Learning Objectives:

- Students understand that Newton's laws predict the motion of most objects
- Students know that the laws of conservation of energy and momentum provide a way to predict and describe the movement of objects
- Students understand that energy cannot be created or destroyed, although in many processes energy is transferred to the environment as heat
- Students learn that waves have characteristic properties that do not depend on the type of wave
- Students understand that electric and magnetic phenomena are related and have many practical applications
- Students know changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors
- Students know plasmas, the fourth state of matter, contain ions or free electrons or both and conduct electricity
- Students know electric and magnetic fields contain energy and act as vector force fields
- Students know the force on a charged particle in an electric field is  $qE$ , where  $E$  is the electric field at the position of the particle and  $q$  is the charge of the particle
- Students know how to calculate the electric field resulting from a point charge
- Students know static electric fields have as their source some arrangement of electric charges

# Syllabus Sample

## Unit 1: Mechanics Chapter 4: Linear Motion

### Week 3

#### The Big Idea

- ❖ You can describe the motion of an object by its position, speed, direction, and acceleration.

#### Objectives, know that:

- ❖ An object is moving if its position relative to a fixed point is changing.
- ❖ You can calculate the acceleration of an object by dividing the change in its velocity by time.
- ❖ For each second of free fall, an object falls a greater distance than it did in the previous second.
- ❖ The acceleration of an object in free fall is about 10 meters per second per second squared. ( $10\text{m/s}^2$ ).
- ❖ Air resistance affects falling objects.
- ❖ You can calculate the speed of an object by dividing the distance covered by time.(1a)

### Assignments

#### Textbook

1. Read pages 46-61
2. Do questions 2, 3, 6, 7, 10, 11, 14, 16, 18, 21, 27, 28, 32, 34, 35, 38, 39, 42, 44, 46, 54, 57 on pages 62-67
3. Do **discover!** Activity on page 55

#### Practice Book

Complete 4-1 *Free Fall Speed* and 4-2 *Hang Time*

#### Laboratory Manual

Complete Experiment #2: Data Collection

#### Week 3 Assignment Checklist

- Questions on pages 62-67
- Practice Book pages 13-17
- Laboratory Experiment #2
- Do **discover!** Activity on page 55

# Outline for Physics

## **Lesson 1: About Science and Mechanical Equilibrium**

- A) Mathematics: the language of science
- B) The scientific method
- C) Force
- D) Equilibrium
- E) Vectors

## **Lesson 2: Newton's First Law of Motion- Inertia**

- A) Aristotle on motion
- B) Copernicus and Galileo
- C) Newton's law of inertia
- D) Mass
- E) The moving Earth

## **Lesson 3: Linear Motion**

- A) Motion is relative - speed
- B) Instantaneous & average speed
- C) Velocity - acceleration
- D) Free fall

## **Lesson 4: Projectile Motion**

- A) Vector and scalar quantities
- B) Velocity vectors
- C) Components of vectors
- D) Projectile motion
- E) Projectiles

## **Lesson 5: Newton's Second Law of Motion**

- A) Force causes acceleration
- B) Mass resists acceleration
- C) Newton's second law
- D) Friction
- E) Applying force-pressure
- F) Free fall
- G) Falling and air resistance

**Lesson 6: Newton's Third Law of Motion**

- A) Forces and interactions
- B) Newton's third law of motion
- C) Action and reaction
- D) Defining systems
- E) The horse-cart problem
- F) Action equals reaction

**Lesson 7: Momentum**

- A) Momentum
- B) Impulse changes momentum
- C) Bouncing - conservation of momentum
- D) Collisions
- E) Momentum vectors

**Lesson 8: Energy**

- A) Work - power
- B) Energy
- C) Conservation of energy
- D) Machines - efficiency
- F) Sources of energy - energy for life

**Lesson 9: Circular Motion**

- A) Rotation and revolution
- B) Rotational speed
- D) Centripetal force and centrifugal force
- E) Centrifugal force in a rotating reference frame

**Lesson 10: Rotational Equilibrium**

- A) Torque
- B) Torque – center of mass and center of gravity
- C) Center of gravity of people
- D) Stability

**Lesson 11: Rotational Motion**

- A) Rotational inertia
- B) Angular momentum
- C) Conservation of angular momentum
- D) Simulated gravity

**Lesson 12: Universal Gravitation**

- A) Universal law of gravity
- B) Universal gravitational constant
- C) Gravity & distance: the inverse square law
- D) Weight & weightlessness - ocean tides
- E) Gravitational fields - Einstein's theory of gravitation
- F) Black holes - universal gravitation

**Lesson 13: Satellite Motion**

- A) Earth satellites
- B) Circular and elliptical orbits
- C) Energy conservation and satellite motion
- D) Kepler's laws of planetary motion
- E) Escape speed

**Lesson 14: Special Relativity – Space and Time and Relativity – Motion, Mass, Energy and Gravity**

- A) Space Time
- B) Postulates of special relativity
- C) Time dilation
- D) Space and time travel
- E) Length contraction
- F) Momentum and inertia in relativity
- G) Equivalence of mass and energy
- H) The correspondence principle
- I) General relativity

**Lesson 15: The Atomic Nature of Matter**

- A) Elements
- B) Atoms
- C) Molecules
- D) Compounds
- E) The atomic nucleus
- F) Electrons
- G) Phases of matter

**Lesson 16: Solids**

- A) Crystal structure
- B) Density
- C) Elasticity
- D) Compression and tension
- E) Scaling

**Lesson 17: Liquids**

- A) Liquid pressure
- B) Buoyancy - Archimedes' Principle
- C) What makes an object sink or float?
- D) Flotation - Pascal's Principle
- E) Pascal's Principal

**Lesson 18: Gases**

- A) The atmosphere - atmospheric pressure
- B) Boyle's Law - buoyancy of air
- C) Bernouli's Principle

**Lesson 19: Temperature, Heat, & Expansion**

- A) Temperature
- B) Heat - measuring heat
- C) Specific heat capacity
- D) Thermal expansion
- E) Expansion of water

**Lesson 20: Heat Transfer and Change of Phase**

- A) Conduction - convection - radiation
- B) Newton's law of cooling
- C) Global Warming and the Greenhouse Effect
- D) Solar power
- E) Controlling heat transfer
- A) Evaporation - condensation
- B) Boiling and freezing
- C) Regelation
- D) Energy and changes of phase

**Lesson 21: Thermodynamics**

- E) Absolute zero - Internal energy
- F) First law of thermodynamics
- G) Adiabatic processes - meteorology & the first law
- H) Second law and third laws of thermodynamics
- I) Order tends to disorder - entropy

**Lesson 22: Vibrations & Waves**

- A) Vibrations of a pendulum
- B) Wave description, motion, & speed
- C) Transverse & longitudinal waves
- D) Interference - Doppler effect
- E) Bow & shock waves

**Lesson 23: Sound and Light**

- A) Origin of sound
- B) Nature of sound in air
- C) Media that transmit sound
- D) Speed of sound in air
- E) Loudness – frequency - vibration
- F) Resonance – interference – beats
- G) The speed of light
- H) Electromagnetic waves
- I) Transparent – Opaque – Polarization

**Lesson 24: Color**

- A) Selective reflection - selective transmission
- B) Mixing colored light
- C) Mixing colored pigments
- D) Why the sky is blue
- E) Why sunsets are red
- F) Why clouds are white
- G) Why water is greenish blue

**Lesson 25: Reflection & Refraction**

- A) Reflection - principle of least time
- B) Law of reflection - plane mirrors
- C) Refraction - cause of refraction
- D) Prisms and rainbows

**Lesson 26: Lenses**

- A) Converging and diverging lenses
- B) Image formation
- C) The eye

**Lesson 27: Diffraction and Interference**

- A) Huygens' Principle
- B) Diffraction - interference
- C) Laser light
- D) The hologram

**Lesson 28: Electrostatics**

- A) Electrical forces & charges
- B) Conservation of charge - Coulumb's Law
- C) Conductors & insulators - charging
- D) Charge polarization - electric field

**Lesson 29: Electrical Fields and Potential Energy and Electric Current**

- A) Electric fields and shielding
- B) Electric potential energy
- C) Electric Potential
- D) The Van de Graaff Generator
- E) Flow of charge - electric current
- F) Voltage sources - electrical resistance
- G) Ohm's Law - direct current & alternating current
- H) Speed & source of electrons in a circuit
- I) Electric power - electric circuits

**Lesson 30: Electric Circuits**

- A) A battery and a bulb
- B) Electric circuits
- C) Series and parallel circuits
- D) Schematic diagrams
- E) Combining resistors
- F) Parallel circuits

**Lesson 31: Magnetism**

- A) Magnetic forces, poles, fields, & domains
- B) Electric currents & magnetic fields
- C) Electromagnets - magnetic force on moving charged particles
- D) Magnetic force on current carrying wires
- E) Earth's magnetic field

**Lesson 32: Electromagnetic Induction**

- A) Electromagnetic induction - Faraday's Law
- B) Generators & alternating current
- C) Power production - self induction
- D) Power transmission
- E) Induction of electric and magnetic fields
- E) Electromagnetic Waves

**Lesson 33: The Atom and the Quantum**

- A) Light quanta
- B) Photoelectric effect - wave particle duality
- C) Waves as particles
- E) Particles as waves: electron diffraction
- F) Quantum physics
- G) Predictability and chaos

**Lesson 34: The Atomic Nucleus and Radioactivity**

- A) Discovery of the atomic nucleus
- B) Radioactive decay
- C) Isotopes – half-life
- D) Transmutation
- E) Carbon and uranium dating

**Lesson 35: Nuclear Fission and Fusion**

- A) Nuclear fission
- B) Uranium enrichment
- C) Nuclear fission & fission reactors
- D) Plutonium - the Breeder Reactor
- E) Fission power - mass-energy equivalence
- F) Nuclear fusion - controlling fusion

**Lesson 36: Final Exam**