DISCOVER PHYSICS

Scope & Sequence

This honors level high school course provides a comprehensive introduction to the fundamental principles of physics. Students will engage in rigorous study, problem-solving activities, and hands-on experimentation to help them understand the laws governing our physical world. Students delve into topics spanning motion, forces, energy, waves, electromagnetism, and the revolutionary concepts of relativity and quantum physics with an emphasis on mathematical applications for modeling natural phenomena.

Lesson 1: Introduction to Physics

- "Laws" of physics
- Proportions and mathematical models
- Measurement and units
- Graphing as a modeling tool

Lesson 2: A Brief History of Physics

- Natural philosophy
- Classical physics
- Modern physics
- Aristotle, Galileo, Newton, and Einstein

Lesson 3: Vibrations & Waves

- Vibrations and energy
- Period, frequency, and wavelength
- Amplitude
- Interference
- Wave equation

Lesson 4: Sound Waves

- Medium of transmission
- Speed of sound
- Interference and acoustics
- Doppler effect

Lesson 5: Light & Color

- Electromagnetic waves and the electromagnetic spectrum
- Energy, frequency, and wavelength
- Rods and cones
- Color absorption and emission

Lesson 6: Wave Optics

- Reflection and refraction
- Mirrors and lenses
- Lensmaker's equation

Lesson 7: Temperature & Heat

- Thermal energy
- Absolute vs relative temperature
- Melting, freezing, boiling, and condensing
- State vs temperature and pressure
- Heat capacity

Lesson 8: Heat Transfer

- Conservation of energy
- Conduction, convection, and radiation
- Newton's law of cooling

Lesson 9: Thermodynamics

- Three laws of thermodynamics
- Entropy
- "Zeroth" law of thermodynamics
- Heat cycles
- Engines

Lesson 10: Exam 1

Lesson 11: Linear Motion (Part 1)

- Frame of reference and measuring motion
- Speed, direction, and velocity
- Distance vs time graphs
- Constant motion

Lesson 12: Linear Motion (Part 2)

- Changing motion, acceleration
- Average speed vs instantaneous speed
- Distance and velocity
- Acceleration graphs
- Acceleration due to gravity

Lesson 13: Two-Dimensional Motion

- Vectors/2-D math
- Changing direction as acceleration
- Solving simultaneous equations
- Projectile motion
- Circular motion

Lesson 14: Newton's Laws of Motion

- Newton's first law
- Inertia and mass
- Newton's second law
- Cause and effect
- Newton’s second law
- Newton's third law

Lesson 15: Specific Forces

- Gravity
- “Normal” force
- Friction and air resistance
- Pressure and force
- Centripetal force

Lesson 16: Momentum

- Defining momentum
- Momentum and Newton's 2nd law
- Law of conservation of momentum
- Closed systems and collisions

Lesson 17: Energy of Motion

- Defining and measuring energy
- Potential and kinetic energy
- Conservation of energy

Lesson 18: Rotational Motion

- Similarity between rotational and linear motion
- Rotational speed and acceleration
- Linear motion as part of rotational motion

Lesson 19: Rotational Mechanics

- Force vs torque
- Mass vs rotational inertia
- Rotational inertia of various solid shapes
- Newton's laws in rotation

Lesson 20: Exam 2

Lesson 21: Electrostatics

- Electric charge
- Polarization
- Scientific Notation
- Coulomb's law and problem solving

Lesson 22: Electric Fields

- Electric potential
- Potential differences
- Fields of point charges
- Fields of surfaces and shapes
- Capacitors

Lesson 23: Electric Current

- Conventional current
- Conductors vs resistors
- Closed vs open circuits
- Potential and voltage
- Ohm's law

Lesson 24: Series & Parallel Circuits

- Circuit diagrams and features
- Series vs parallel definitions
- Ohm's law in series and parallel

Lesson 25: Magnetism

- North vs South
- Strength of force and magnetic fields
- Magnetic equations

Lesson 26: Electromagnetism

- Moving charges
- Changing fields
- Interconnectivity
- Right-hand rule

Lesson 27: Exam 3

Lesson 28: Special Relativity pt. 1

- Classical relativity
- Spacetime
- Time dilation and time travel
- Lorentz Transformation

Lesson 29: Special Relativity pt. 2

- Length Contraction
- Energy and Momentum
- Mass-Energy Equivalence

Lesson 30: Universal Gravitation

- Kepler’s laws of planetary motion
- Newton's law of gravity
- Einstein’s general relativity

Lesson 31: Atomic & Nuclear Physics

- Atomic structure
- Nuclear radiation
- Nuclear fission and fusion

Lesson 32: Introduction to Quantum Physics

- Quanta defined
- Blackbody radiation
- Planck's constant
- The photoelectric effect
- Electron energy levels
- Standard Model of particle physics

Lesson 33: Quantum Systems

- Two-slit interference of light
- Two-slit Interference of other particles
- de Broglie Wavelengths
- Wave functions and Schrodinger’s wave equations
- Heisenberg’s Uncertainty Principle

Lesson 34: Quantum Theories (Things Just Got Weirder)

- Copenhagen interpretation
- Schrodinger’s cat
- Pilot wave theory
- Many worlds theory
- Quantum tunneling
- Quantum entanglement

Lesson 35: Exam 4