

HS - Honors Physics 2 - 11-12

Huntingdon Area School District

UNITS (4/4 SELECTED)

SUGGESTED DURATION

-  Unit 1: States of Matter *25 lessons*
-  Unit 2: Electricity and Magnetism *56 lessons*
-  Unit 3: Electromagnetic Waves and Light *34 lessons*
-  Unit 4: Special Relativity and Nuclear Physics *41 lessons*

Unit 1: States of Matter

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UNIT OVERVIEW

The air is a fluid, and this unit examines the forces and pressures that fluids exert when they are at rest and when they are in motion. Students will seek to answer the question, "How will the fluid flow through a device?"

STANDARDS/EXPECTATIONS

Pennsylvania - Grade 9-12 - Science, Technology & Engineering, And Environmental Literacy & Sustainability Standards (STEELS) (2023)

3.2.9-12.N

3.5.9-12.DD

3.5.9-12.Y

3.5.9-12.X

3.5.9-12.I

BIG IDEAS

Big Ideas

- Students will explore fluids, pressure, the gas laws, thermal expansion and plasma. This will lead them to understand the basic properties of fluids.
- Students will explore cohesive and adhesive forces, evaporation and condensation. This will lead to them to understand that for thin tubes, like those in a microfluidic device, cohesive and adhesive forces play a major role in how fluids flow.
- Students will explore Pascal's Principle, buoyancy, Archimedes Principle, and Bernuolli's. This will lead them to understand how liquids flow in larger tubes, such as hoses and household pipes.
- Students will explore the molecular structure and thermal expansion of solids. This will lead them to understand solids behave differently than fluids

ESSENTIAL QUESTIONS

Essential Questions

- What is a fluid and what are its properties?
- How do the forces between particles in a fluid affect its behavior?
- What principles describe the behavior and motion of fluids?
- How are solids different from fluids?

Unit 1: States of Matter

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LEARNING TARGETS: KNOWLEDGE & SKILLS

Knowledge	Skills
Students will know (Acquired Knowledge)	Students can do (Acquired Skill)
properties of fluids and solids	Design a solution to above ground storage tank collapses (Teach Engineering)
cohesive vs adhesive forces and their effects on fluids	Solve Statics problems using the buoyant force.
Pascal's Principle	Apply the equation of continuity.
Archimedes Principle	Apply Bernuolli's equation for moving fluids.
Bernuolli's Principle	
thermal expansion of solids	

EVIDENCE OF LEARNING & ASSESSMENT

Name of Assessment	Type (formative, summative, project-based, diagnostic)	Description
States of Matter Test	Summative	
Lab Reports	project based	
Teach Engineering Fluid Dynamics Project	project based	Teams are challenged to come up with improved storage tank designs to make them less vulnerable to uplift, displacement and buckling in storm conditions. Teams present their analyses and design ideas in short class presentations.

Unit 2: Electricity and Magnetism

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UNIT OVERVIEW

This unit will cover the concepts of electricity and magnetism and ultimately how they are interrelated. Students will be able to describe how charges interact, move through insulators and conductors, and how we utilize this understanding to create circuits. Students will compare and contrast electric and magnetic fields, and finally understand electromagnetism. Students will seek to answer the following questions; "Why does the rod cause the water to bend?", "How does energy get from the power plant to the lights in your home?", "What makes this electromagnet stronger than a typical refrigerator magnet?" and "What causes the Northern Lights?"

STANDARDS/EXPECTATIONS

Pennsylvania - Grade 9-12 - Science, Technology & Engineering, And Environmental Literacy & Sustainability Standards (STEELS) (2023)

3.2.9-12.N

3.2.9-12.S

3.2.9-12.I

3.2.9-12.M

3.2.9-12.P

3.2.9-12.O

3.2.9-12.Q

3.2.9-12.U

3.2.9-12.W

3.2.9-12.X

3.5.9-12.OO

3.5.9-12.PP

Unit 2: Electricity and Magnetism

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BIG IDEAS

Big Ideas

- Students will explore the evidence we have for electric charge and how some materials are electric conductors while others are electric insulators.
- Students will explore how objects can be charged, as well as Coulomb's Law.
- Students will explore electric fields and how they can be modeled.
- Students will explore electrical potential energy, capacitors and how the charge of an electron was discovered.
- Students will explore current, electrical energy, circuit diagrams and Ohm's Law.
- Students will explore the relationship between electrical energy, power, potential difference, and resistance.
- Students will explore series and parallel circuits and analyze them using Kirchhoff's rules.
- Students will explore electrical safety devices and combined circuits, including ammeters and voltmeters.
- Students will explore the properties of magnets, magnetic domains, magnetic fields, and electromagnets.
- Students will explore the effects of magnetic forces on current carrying wires and moving charged particles, as well as related applications, including galvanometers and motors.
- Students will explore how changing magnetic fields induce currents and how generators work.
- Students will explore Lenz's law, eddy currents, self-inductance and transformers.
- Students will explore Thomson's experiments with cathode ray tubes and mass spectrometers, both of which demonstrate how charged particles behave in electric and magnetic fields.
- Students will explore the properties and technological applications of electromagnetic waves.

Unit 2: Electricity and Magnetism

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ESSENTIAL QUESTIONS

Essential Questions

- Why does rubbing your shoes on the carpet lead to a shock when you touch a metal door knob?
- How can objects be electrically charged?
- How can we explain how electric forces work at a distance?
- What is a capacitor and how does it work?
- What is an electric circuit?
- How do we use electrical energy?
- How can you build a simple circuit to fit the needs of a given situation?
- How are circuits used in your home and school?
- Why are some materials magnetic and some are not?
- What role do magnetic forces play in everyday life?
- How can a magnet generate a current?
- How do transformers help with the distribution of electricity in the power grid?
- How does a mass spectrometer work?
- What do electric and magnetic fields have to do with light?

LEARNING TARGETS: KNOWLEDGE & SKILLS

Knowledge	Skills
Students will know (Acquired Knowledge)	Students can do (Acquired Skill)
Coulomb's Law	Create an electrical circuit that accomplishes an assigned task.
Kirchoff's Rules	Calculate voltages, resistances, and current for various circuits.
Ohm's Law	Create a functional electromagnetic crane .
Right Hand Rule	Induce a current through a magnetic field and vice versa
Lenz's law	

Unit 2: Electricity and Magnetism

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EVIDENCE OF LEARNING & ASSESSMENT

Name of Assessment	Type (formative, summative, project-based, diagnostic)	Description
Chapter 18 Test - Electric forces, electric fields, electric potential, potential energy	summative	
Chapter 19 Test - Electrical Circuits	summative	
Lighthouse Circuit Project	project based	
Lab reports	project based	
Chapter 20 Test - Magnetism and magnetic forces	summative	
Chapter 21 Test - Electromagnetism	summative	
Hydraulic E-M Crane Project	project based	

Unit 3: Electromagnetic Waves and Light

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UNIT OVERVIEW

Having previously learned how fluids move, and how electricity moves, we now turn our attention to the concept of Electromagnetic waves. We will discuss the fundamentals of light, behavior of light through reflection and refraction. Students will complete ray diagrams to show the locations of images and objects when utilizing both lenses and mirrors. Lastly, they will build upon their previous knowledge of wave interference to understand its effects on light. Students will seek to answer the questions "What does the light from a distant star or supernova tell us about it?", How does light transmit information through a communication network?, What makes this hummingbird's feathers appear shiny and shimmery?.

STANDARDS/EXPECTATIONS

Pennsylvania - Grade 9-12 - Science, Technology & Engineering, And Environmental Literacy & Sustainability Standards (STEELS) (2023)

3.2.9-12.V

3.2.9-12.T

BIG IDEAS

Big Ideas

- Students will explore the ray model of how light travels, illumination, and the speed of light.
- Students will explore how the wave nature of light explains diffraction, color, polarization, and the Doppler shift of light.
- Students will explore the law of reflection and images formed by plane and curved mirrors.
- Students will explore Snell's Law of refraction, total internal reflection, and the dispersion of light.
- Students will explore how lenses, including those in the human eye and in optical equipment, are used to form images.
- Students will explore the double slit interference and thin film interference.
- Students will explore single slit diffraction and diffraction gratings.

Unit 3: Electromagnetic Waves and Light

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ESSENTIAL QUESTIONS

Essential Questions

- How does distance affect how bright a star appears?
- How do scientists use the Doppler shift to determine how stars and galaxies are moving?
- Why does light reflected from a mirror make an image while light reflected from a piece of paper does not?
- What are some advantages and disadvantages of curved mirrors compared to plane mirrors?
- What happens to light when it enters a new medium?
- How are systems of lenses used to make optical devices?
- How do bubbles produce a rainbow effect?
- How do DVD's produce a rainbow effect?

LEARNING TARGETS: KNOWLEDGE & SKILLS

Knowledge	Skills
Students will know (Acquired Knowledge)	Students can do (Acquired Skill)
reflection and refraction	draw ray diagrams for lenses and mirrors and combinations thereof.
Snell's Law	Calculate indices of refraction given experimental data.
wave particle duality of light	describe and explain the double slit experiment.

Unit 3: Electromagnetic Waves and Light

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EVIDENCE OF LEARNING & ASSESSMENT

Name of Assessment	Type (formative, summative, project-based, diagnostic)	Description
Lab reports	project based	
Chapter 15 Test	summative	
Chapter 16 Test	summative	
Chapter 17 Test	summative	

Unit 4: Special Relativity and Nuclear Physics

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UNIT OVERVIEW

Students will seek to answer the question, "How does the Sun produce energy and how can we replicate it?".

STANDARDS/EXPECTATIONS

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3.2.9-12.H

3.2.9-12.G

3.3.9-12.A

BIG IDEAS

Big Ideas

- Students will explore the structure of the nucleus, the forces acting on the particles within it, and the energy binding its particles together.
- Students will explore radioactive decay, fission and fusion.
- Students will explore how scientists use particle accelerators and detectors to determine the fundamental make up of the universe, which is described by the Standard Model.

ESSENTIAL QUESTIONS

Essential Questions

- What is inside an atom?
- How can nuclear reactions be useful?
- How do scientists discover particles that they cannot see?

Unit 4: Special Relativity and Nuclear Physics

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LEARNING TARGETS: KNOWLEDGE & SKILLS

Knowledge	Skills
Students will know (Acquired Knowledge)	Students can do (Acquired Skill)
subatomic nuclear particles	balance nuclear reactions.
fission	explain time dilation according to relativity.
fusion	predict the products of fission and fusion reactions.
Einstein's theory of special relativity	
nuclear decay (alpha, beta, and gamma)	

EVIDENCE OF LEARNING & ASSESSMENT

Name of Assessment	Type (formative, summative, project-based, diagnostic)	Description
Lab reports	project based	
AP Ch. 28 Test	summative	
AP Ch. 29 Test	summative	
AP Ch. 31 Test	summative	
AP Ch. 32 Test	summative	