

PHYSICS | Curriculum Map and Pacing Guide

<p>COURSE DESCRIPTION: Physics is a standard college preparatory laboratory-based introductory course. Students are responsible for familiarity with the metric system, knowledge of the atom, and scientific notation from previous courses. Concept development, problem solving and application of physics principles are central to learning. Major topics include motion in uniform, accelerated motion in one and two dimensions, circular motion, vectors, Newton’s laws, gravitation, friction, energy, work, power collisions, momentum, waves, simple harmonic motion, sound, electrostatics, DC electricity, Ohm’s law, simple circuits, magnetism, electromagnetism, light, and the electromagnetic spectrum.</p>	<p>Course SCI350 1 year, 1 credit Grades 11-12 Prerequisite: Chemistry, Algebra 2, teacher recommendation</p>
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QUARTER 1		
Topic: Newton’s First Law		
Key Terms: inertia, mass, weight, equilibrium, vector, scalar, force, force diagrams, resultant		
Measurable Skills: making predictions, problem solving, investigating, reading graphs, analyzing data		
Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.F.1	Describe Aristotle’s concept of motion.	Tablecloth pulling demo
	Describe Copernicus’ idea about Earth’s motion.	Vector ILD
	Describe Galileo’s idea about when a force is needed to keep objects in motion.	Inertia ball demo
	State Newton’s first law of motion.	
	Describe the relationship between mass and inertia.	
	Explain how the law of inertia applies to objects in motion.	
	Distinguish between a vector quantity and a scalar quantity.	
	Distinguish between force and net force.	
	Describe the equilibrium rule and give examples.	
	Distinguish between support force and weight.	
	Give examples of moving objects that are in equilibrium.	
Determine the resultant of a pair of vectors.		

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QUARTER 1

Topic: Linear Motion

Key Terms: speed, instantaneous speed, average speed, velocity, vector quantity, scalar quantity, acceleration, free fall

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.M.2 P.F.6	Explain how you can tell an object is moving.	Frames of reference / YouTube
	Define frame of reference.	Meeting point
	Compare and contrast displacement vs distance.	Tortoise and hare
	Describe how you can calculate speed.	g ball
	Distinguish between a vector quantity and a scalar quantity.	
	Distinguish between speed and velocity.	
	Describe how you can calculate acceleration.	
	Describe the acceleration of an object in free fall.	
	Describe how air resistance affects the motion of falling objects.	
	Explain the relationship between velocity and acceleration.	

QUARTER 1

Topic: Interpreting Motion Graphs

Key Terms: coordinate system, position, time displacement, distance slope, velocity, speed, average speed, instantaneous speed, uniform velocity, acceleration, average acceleration, instantaneous acceleration, uniform acceleration

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.M.1	Interpret and create position vs time graphs.	1D - Motion 1 workshop physics
	Explain how the slope of p-t graph is velocity.	1D - Motion 2 workshop physics
	Compare positive vs negative position.	KIN2 ILD
	Compare positive vs negative velocity.	
	Interpret and create velocity vs time graphs.	
	Explain how the slope is acceleration.	
	Compare negative vs positive acceleration for both positive and negative velocities.	
		The area under a v-t graph is the displacement.

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Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
	Use slope idea to calculate various motion quantities from motion graphs.	
	Use the area under a curve to calculate various motion quantities from motion graphs.	

QUARTER 1

Topic: Newton's Second Law of Motion

Key Terms: acceleration, static friction, kinetic friction, mass, kilogram, weight, newton, Newton's 2nd law of motion, g, free fall, terminal speed, terminal velocity

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.F.2	State the relationship between acceleration and net force.	Force, mass, motion workshop physics
P.F.4	List the factors that affect the force of friction between surfaces.	N1 and N2 ILD
P.F.5	Calculate between static and kinetic (sliding) friction	Penny and feather demo
	Distinguish between mass and weight.	Incline plane inquiry
	State the relationship between acceleration and mass.	Elevator inquiry
	State and explain Newton's second law of motion.	Applications of Newton's Law 7.14-7.15 workshop physics
	Explain why the acceleration of an object in free fall does not depend upon the mass of an object.	
	List the factors that affect the air resistance force on an object.	

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QUARTER 2

Topic: Newton's Third Law of Motion

Key Terms: Newton's third law, action force, reaction force, system

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.F.1	Define force as part of an interaction.	N3 ILD
	State Newton's third law of motion.	Push me pull me demo
	Describe how to identify a pair of action-reaction forces.	
	Explain why the accelerations caused by an action force by a reaction force do not have to be equal.	
	Explain why an action force is not cancelled by the reaction force.	
	Explain what must occur in every interaction between things.	

QUARTER 2

Topic: Momentum

Key Terms: momentum, impulse, conservation of momentum, elastic collision, inelastic collision

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.F.7	Calculate momentum.	MOM ILD
	Calculate impulse and describe how it affects changes in momentum.	1D Collisions workshop Physics
	Explain why an impulse is greater when an object comes to a sudden stop.	Egg toss demo
	State the law of conservation of momentum.	Momentum mallet demo
	Describe how the conservation of momentum applies to collisions.	Air puck collisions demo
	Describe how the vector nature of momentum affects the law of conservation of momentum.	Medicine ball transfer Spring apart carts

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QUARTER 2

Topic: Work and Energy

Key Terms: work, joule, power, energy, mechanical energy, potential energy, Kinetic energy, work-energy theorem, law of conservation of energy, Hooke's law

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.E.1	Define and describe work.	ENER ILD
P.E.2	Define and describe power.	Work and energy workshop physics
P.E.3	State the two forms comprising mechanical energy.	CONSOENERGY orkshop physics
P.E.4	State three forms of potential energy.	Nose smash (bowling ball demo)
P.F.2	Calculate gravitational potential energy.	Stopped pendulum
P.F.3	Calculate elastic potential energy.	Spring inquiry
	Calculate Hooke's Law.	
	Define kinetic energy.	
	Describe how work and kinetic energy are related.	
	State the work-energy theorem.	
	State the law of conservation of energy.	

QUARTER 2

Topic: Circular Motion, Centripetal Force and Gravitation

Key Terms: rotation, revolution, circular motion, linear speed, tangential speed, angular (rotational) speed, centripetal force, Universal Law of Gravity, Inverse square law, appear, weightlessness

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.M.2 P.M.3	Define circular motion.	Application of Newton's Laws Workshop physics
	Describe the relationship among tangential speed, angular (rotational) speed and radial distance.	Loop the loop demo
	Describe the factors the affect the centripetal force acting on an object.	Waiter's pail demo
	Define the Universal Law of Gravity.	Hoberman sphere demo

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Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
	Define the Universal Gravitational Constant.	Inertial balance inquiry
	Show how gravity and distance are related.	
	Describe the state of weightlessness.	
	Determine conditions which must be present for weightlessness to occur.	

QUARTER 2

Topic: Motion in 2D

Key Terms: projectile, parabola

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.M.2	Describe the components of projectile motion.	PROJ ILD
P.M.3	Describe the downward motion of a horizontally launched projectile.	Class hoop challenge
	Calculate values for projectile motion.	
	Solve problems when projectiles are launched at an angle.	

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QUARTER 3

Topic: Wave Properties

Key Terms: crest, trough, sine curve, amplitude, wavelength, frequency, hertz, period, transverse wave, longitudinal wave, wave speed, wave interference, destructive interference, constructive interference, standing wave, node, antinode, Doppler effect, electromagnetic wave, electromagnetic spectrum

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.W.1	Describe the period of a wave.	Wave generator
	Describe the characteristics and properties of waves.	Slinky inquiry
	Describe wave motion.	
	Describe how to calculate the speed of a wave.	
	Give an example of transverse wave.	
	Give an example of a longitudinal wave.	
	Explain what causes interferences patterns.	
	Describe how standing waves form.	
	Describe how the apparent frequency of waves change as a wav source moves.	
	Define how electromagnetic waves travel.	
	Compare and contrast the components of the electromagnetic spectrum.	

QUARTER 3

Topic: Reflection and Refraction

Key Terms: reflection, medium, incident ray, reflected ray, normal, angle of incidence, angle of reflection, plane mirror, diffuse reflection, law of reflection, refraction, dispersion, converging lens, diverging lens, convex lens, principal axis, focal point, focal length, virtual image, real image, aberration, total internal reflection, critical angle

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.W.1	Describe what happens when a wave reaches a boundary between two media.	RRLT ILD
	Describe the law of refraction.	IMFL ILD

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QUARTER 3

Topic: Reflection and Refraction

Key Terms: reflection, medium, incident ray, reflected ray, normal, angle of incidence, angle of reflection, plane mirror, diffuse reflection, law of reflection, refraction, dispersion, converging lens, diverging lens, convex lens, principal axis, focal point, focal length, virtual image, real image, aberration, total internal reflection, critical angle

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
	Describe the type of images that are produced by plane mirrors.	MIRR ILD
	Describe what happens when light is incident on a rough surface.	Ray tracing lab
	Describe what happens to sound energy that is not reflected.	Ripple tank inquiry
	Describe what happens when a wave that is traveling at an angle changes its speed upon crossing a boundary between two media.	Disappearing beaker demo
	Describe how a lens forms an image.	Laser water stream demo
	Construct ray diagram.	
	Distinguish between types of images formed by lenses.	
	Describe what causes sound waves to refract.	
	Describe what causes the refraction of light.	
	Describe what causes total internal reflection to occur.	

QUARTER 3

Topic: Light Waves

Key Terms: Huygens' Principle, Diffraction, Superposition, Interference, Wave Particle Duality

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.W.2	Describe what Huygens stated about light waves.	Single/double slit inquiry
	Describe what affects the extent of diffraction.	
	Explain how interference affects wave amplitudes.	
	Describe what Young's interference experiment demonstrates	
	Describe wave-particle duality of light.	
	Describe how laser light is emitted.	

QUARTER 3

Topic: Electrostatics

Key Terms: charge, Coulombs Law, conservation of charge, coulomb, conductor, insulator, semiconductor, superconductor, charging by contact, charging by induction, grounding, Electrostatic Forces, Electric Field, Electric Potential Energy, Electric Potential (Voltage), capacitor

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.EM.1	Describe the fundamental rule at the base of the all electrical phenomena.	Electrostatics inquiry
P.EM.2	Explain how an object becomes electrically charged.	Van de Graaff demo
P.EM.3	Describe Coulomb's law.	Electric fields workshop physics
	Distinguish between a good conductor and a good insulator.	EFFP ILD
	Describe two ways electric charges can be transferred.	Electric field line overhead demo
	Describe what happens when a charged object is placed near a conducting surface.	Laser box and net demo
	Describe what happens when an insulator is in the presence of a charged object.	
	Describe how to measure the strength of an electric field at different points.	
	Describe how electric fields are represented by vectors and by electric field lines.	
	Describe how objects can be completely shielded from electric fields.	
	Explain why a charged objects in an electric field is considered to have electrical potential energy.	
	Distinguish between electrical potential energy and electric potential.	
	Describe how electrical energy can be stored.	
	Describe the operation of a Van de Graaff generator.	

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QUARTER 4

Topic: Electric Current

Key Terms: electric current, ampere, voltage source, electric resistance, ohm, Ohm's law, circuit, series circuit, parallel circuit, schematic diagram, equivalent resistance

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.EM.4	Describe the flow of electric charge.	DC current workshop physics
	Describe what is happening inside a current-carrying wire.	INDC ILD
	Give examples of voltage sources.	SPC ILD
	Describe factors that affect the resistance of a wire.	Series and parallel demo
	Describe Ohm's law.	
	Explain the causes of electric shock.	
	Describe the drift speed of conduction electrons in a current-carrying wire.	
	Identify the source of conduction electrons in a circuit.	
	Relate the electric power used by a device to current and voltage.	
	Describe the configuration of a working circuit.	
	Describe the characteristics of a series circuits.	
	Describe the characteristics of a parallel circuits.	
	Determine the equivalent resistance of circuits having two or more resistors.	

QUARTER 4

Topic: Magnetism/Electromagnetism

Key Terms: Magnetic Poles, magnetic fields, magnetic domains, electromagnets, Earth's magnetic field

Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.EM.5 P.EM.6	Explain how magnetic poles affect each other.	Magnetic fields workshop physics
	Describe the magnetic field in space around a magnet.	MAG ILD
	Describe how magnetic fields are produced.	EMIN ILD
	Describe how to make a permanent magnet.	Magnets/magnetic field inquiry

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Measurable Skills: making predictions, problem solving, designing experiments, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
	Describe the magnetic field produced by a current-carrying wire.	
	Explain how to increase the strength of an electromagnet.	
	Describe how a magnetic field exerts a force on a charged particle in the field.	
	Suggest a possible cause for Earth's magnetic field.	

QUARTER 4

Topic: Nuclear Energy

Key Terms: Alpha, beta, gamma rays, Strong force, transmutation, Fission, chain reaction, critical mass, Mass- Energy Equivalence, Fusion, nuclear binding energy, thermonuclear fusion

Measurable Skills: making predictions, problem solving, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
P.E.5	Distinguish among the three types of radiation given off by radioactive elements.	Mouse trap chain reaction demo
	Explain the factors that determine the penetrating power of radiation.	
	Describe why nuclei do not fly apart in spite of the strong repulsive forces in close contact.	
	Explain why a larger nucleus is generally less stable than a smaller nucleus.	
	Predict the missing element during a transmutation reaction.	
	Describe the role of neutrons in causing and sustain nuclear fission.	
	Describe the equivalence of mass and energy.	
	Compare the total mass of the products of fusion to the mass of the nuclei that fused.	
	Calculate energy gain from both fission and fusion reactions.	

QUARTER 4

Topic: Nuclear Energy

Key Terms: Alpha, beta, gamma rays, Strong force, transmutation, Fission, chain reaction, critical mass, Mass- Energy Equivalence, Fusion, nuclear binding energy, thermonuclear fusion

Measurable Skills: making predictions, problem solving, investigating, reading graphs, making graphs, collecting data, analyzing data

Ohio Science Standards (2018)	Student Learning Targets	Learning Activities/Investigations
	Explain why thermonuclear fusion reactions are so difficult to carry out.	

District Instructional Resource:

Hewitt: Conceptual Physics (2015) / Pearson (6-year online subscription: 2019-2020 to 2024-2025)

Standards Alignment:

Ohio Learning Standards (2018) – retrieved Jan. 2, 2019

<http://education.ohio.gov/getattachment/Topics/Learning-in-Ohio/Science/Ohios-Learning-Standards-and-MC/SciFinalStandards121018.pdf.aspx?lang=en-US>