



Physics 24-25 Curriculum Guide

Frequently Used Resources:

- **CK-12 Foundation Exploration Series** – Online interactive physics simulations and tutorials
https://interactives.ck12.org/simulations/physics.html?_gl=1*1qyf5vm*_gcl_au*MTgwMjg1MTQxOS4xNzE4NzI5MTIy*_ga*MTgxMjE1ODE4OC4xNzA2NjM1MTIx*_ga_7PBE4L0PZZ*MTcxODk4MTUwMS4yNi4xLjE3MTg5ODE5NTluMzMuMC45MzEzNjY5ODY.
- **oPhysics** – Online interactive physics simulations created by a retired AP physics teacher of 25 years
- **Physport** –
 - Talking about equity in physics <https://www.physport.org/recommendations/Entry.cfm?ID=124900>
- **Physics Lab Online** – This collection for introductory physics integrates lessons, labs, practice problems, assessments, AP review exercises, simulations, and quizzes in one easily-searched location. <https://www.physicslab.org/TOC.aspx>
- **ACORN Physics Tutorials** – Produced by Seattle Pacific University and funded by the National Science Foundation, ACORN tutorials are designed to support learning environments that attend to conceptual resources in physics and are based on research about student thinking in introductory physics classrooms. <https://www.physport.org/curricula/ACORN/>
- **Magnet Academy** – This is a collection of more than 60 tutorials on concepts, laws, and historical milestones associated with electricity and magnetism. The simulations range in complexity from very simple to highly advanced. Topics include models for electricity, DC current, AC current, capacitance, electromagnetic induction, magnetic field around a wire, and more. The simulations of historical instruments help users visualize the work of pioneers in electricity and magnetism. Magnet Academy is part of a large collection of web-based educational materials for K-20, developed by the National High Magnetic Field Laboratory at Florida State University.
- **Jefferson Lab** – Thomas Jefferson National Accelerator Facility (Jefferson Lab) is a U.S. Department of Energy Office of Science national laboratory
- **TeachEngineering.com** – TeachEngineering was founded in 2001 and is funded by the National Science Foundation (NSF). TeachEngineering continues to expand with published curricula from over 60 different institutions. University engineering faculty, graduate students and K-12 teachers across the nation developed and classroom tested the contents of the TeachEngineering collection.
- **PhET** – Founded in 2002 by Nobel Laureate Carl Wieman, the PhET Interactive Simulations project at the University of Colorado Boulder creates free interactive math and science simulations. PhET sims are based on extensive education research and engage students through an intuitive, game-like environment where students learn through exploration and discovery.

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- **Crash Course Physics & Crash Course Engineering** – Produced in association with PBS Digital Studios, Crash Course produces high quality educational videos that transform the traditional textbook model by presenting information in a fast-paced format.
- **The Physics Classroom** – The Physics Classroom is an online, free to use physics website developed primarily for beginning physics students and their teachers. The website features a variety of sections intended to support both teachers and students in the tasks of learning and teaching physics. The Physics Classroom was written and developed by Tom Henderson. Tom has been teaching physics and chemistry at Glenbrook South High School in Glenview, Illinois since 1989. He is a graduate of the University of Illinois where he received degrees in Chemical Engineering and Chemistry.
- **IOP Spark** – IOP Spark is the online home of physics teaching resources created and published by the Institute of Physics. IOP is the professional body and learned society for physics in the UK and Ireland with an active role in promoting cooperation in physics learning around the world.

Timeline	Unit	Standard	Student Focused Objectives	Resources/ Suggested Activities
Q1	Intro to each other and to physics	(Foundational Concepts & Understandings) 1. Physics as observation and inquiry to deduce laws of the physical world 2. Physics (and science in general) as a continuous process rather than a static body of knowledge 3. Making claims, Supporting with evidence, and Explaining reasoning (CER)		
Q1	Work & Machines	3a. Use mathematical and computational thinking to explain the relationships among work,	SWBAT calculate work, displacement, force, power, and/or time using equations $W = F \cdot d$ and $P = W/t$	Physics Journaling: How do you define “work”? What kinds of things do you consider “work”?

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		power, and time	<p>SWBAT explain, both verbally and with images and models, the quantitative relationships among work, force, displacement, power, work, and time.</p> <p>SWBAT calculate input work (input force * input distance) and output work (output force * output distance) in scenarios of simple machines.</p> <p>SWBAT explain, both verbally and with images and models, the quantitative relationships among input and output force and distance in the application of simple machines.</p>	
Q1	Energy: Focus on MKE & GPE	<p>3b. Create mathematical and graphical representations to depict the transformation of energy from one form to another, including kinetic energy, gravitational potential energy, elastic potential energy, and work due to friction</p> <p>3c. Use models to illustrate the relationship between work performed on an object and the object's total mechanical energy</p>	<p>SWBAT calculate the mechanical kinetic energy and gravitational potential energy of objects using the equations $MKE = 1/2m*v^2$ and $GPE = m*9.8*h$</p> <p>SWBAT explain, both verbally and with images and models, the conservation and transformation of energy in closed systems</p> <p>SWBAT demonstrate the relationship between work and KE mathematically, verbally, and using</p>	<p>PHET: Simulation: Energy Skate Park https://phet.colorado.edu/en/simulations/energy-skate-park</p> <p>Podcast: 99% Invisible–Episode “Curb Cuts” https://99percentinvisible.org/episode/curb-cuts/</p>

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			<p>various models (online simulations, illustrations, 3D manipulatives, etc.)</p> <p>SWBAT build a complex machine comprised of multiple simple machines that demonstrates transfers and transformations of energy and work done on various objects.</p>	
Q1 - Q2	Waves: Focus on Sound	<p>7. Obtain, evaluate, and communicate information regarding the propagation, properties, and applications of waves.</p> <p>7a. Use mathematics and computational thinking to describe the relationship among the velocity, frequency, and wavelength of a propagating wave</p> <p>7b. Use results of investigations to explain the production and characteristics of sound waves including interferences, the Doppler effect, and standing waves</p> <p>7c. Obtain, evaluate and communicate information to explain the properties and behavior of electromagnetic waves</p>	<p>SWBAT identify and calculate the properties of both longitudinal and transverse waves.</p> <p>SWBAT create models (mathematical, narrative, and illustrated) of wave behaviors when presented with specific phenomena.</p> <p>SWBAT build a single string instrument, describe how it produces sound waves, and calculate properties of the sound waves it produces.</p>	<p>PHET: Simulation: Pendulum Lab https://phet.colorado.edu/en/simulations/pendulum-lab Simulation: Sound Waves https://phet.colorado.edu/en/simulations/sound-waves Simulation: Waves on a String https://phet.colorado.edu/en/simulations/wave-on-a-string</p> <p>oPhysics: Wave Tutorials and Simulations: https://ophysics.com/w.html</p> <p>Podcast: Twenty Thousand Hertz “Sound 101 with Bill Nye” https://www.20k.org/episodes/sound101</p> <p>Frontiers for Young Minds: How long is a note?</p>

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				<p>https://kids.frontiersin.org/articles/10.3389/frym.2023.1094312 Acoustics of Classrooms</p> <p>https://kids.frontiersin.org/articles/10.3389/frym.2022.804634</p> <p>Crash Course Physics: The Physics of Music https://www.youtube.com/watch?v=XDsk6tZX55g</p>
Q2	Electricity	<p>6a. Develop and use a model to describe the mathematical relationship among charge, distance, and force as expressed by Coulomb's law</p> <p>6b. Obtain, evaluate, and communicate information regarding the relationship among voltage, current, and power for direct current circuits</p> <p>6c. Create models of series, parallel, and mixed direct current circuits</p> <p>6d. Use mathematics and computational thinking to determine the voltage, current and resistance for an entire circuit and at each resistor or load</p>	<p>SWBAT to create physical, mathematical, drawn, and narrative models of various types of circuits, and explain the relationship between the voltage, current, and resistance in each.</p> <p>SWBAT to construct functioning circuits of various formations using a variety of components.</p> <p>SWBAT to measure the parameters of circuits using multimeters.</p> <p>SWBAT to calculate parameters of circuits using equations defined by Ohm's Law.</p>	<p>PHET: Simulation: Coulomb's Law https://phet.colorado.edu/en/simulations/coulombs-law Simulation: Resistance in a Wire https://phet.colorado.edu/en/simulations/resistance-in-a-wire Simulation: Ohm's Law https://phet.colorado.edu/en/simulations/ohms-law</p>

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Q2 (if time permits)	Intro to vectors			(Use team-building activity with marker and string OR use this for net force)
Q3	Kinematics	<p>1a. Analyze data to create and interpret graphs of position, velocity, and acceleration versus time for one-dimensional motion</p> <p>1d. Use mathematics and computational thinking to solve problems, using kinematics equations in both one- and two-dimensional motion</p>	<p>SWBAT create graphs based on kinematic data collected from measurements taken during in-class experiments.</p> <p>SWBAT make predictions about objects' position, instantaneous velocity, average velocity, and acceleration using kinematic equations.</p>	<p>PHET: Simulation: Vector Addition https://phet.colorado.edu/en/simulations/vector-addition</p> <p>oPhysics: Kinematics Simulations https://ophysics.com/k.html</p>
Q3	Forces & Motion	<p>2a. Evaluation the effects of balanced and unbalanced forces on an object's motion</p> <p>2b. Use mathematical, graphical, and narrative methods to explain the relationships among net force, mass, and acceleration of a single object</p> <p>2c. Create free and fixed body diagrams to model all the forces acting on a single object</p> <p>2d. Create an explanation of the nature of forces and the interactions among them, including</p>	<p>SWBAT calculate the net force acting on an object and will be able to create free-body diagrams illustrating all forces acting on an object in a given situation.</p> <p>SWBAT make predictions about individual forces, net forces, objects' mass, and objects' acceleration using the equation $F_{net} = m * a$.</p> <p>SWBAT explain—verbally, mathematically, and through the creation of graphical models—the relationships and interactions among multiple forces acting on an object.</p>	<p>PHET Simulation: Forces & Motion https://phet.colorado.edu/en/simulations/forces-and-motion</p> <p>Science Journal for Kids: Why do ducklings swim in a line behind their mother? https://www.sciencejournalforkids.org/wp-content/uploads/2022/07/duckling_article_lower_level.pdf</p>

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		<p>tension, friction, gravitation, and normal forces, using free-body diagrams</p> <p>2e. Analyze data to identify the pair of equal and opposite forces between two interacting bodies and relate their magnitudes and directions using Newton's third law.</p>	<p>SWBAT identify and distinguish between balanced forces and force pairs, using Newton's second and third laws.</p>	
Q3	Gravity & Projectile Motion	<p>5b. Develop and use a model to describe the mathematical relationship between mass, distance, and force as expressed by Newton's law of universal gravitation.</p> <p>1b. Analyze free fall motion using one-dimensional kinematics to determine the acceleration due to gravity</p> <p>1c. Analyze and interpret data to explain changes in the vector quantities of position, velocity, and acceleration in two-dimensional projectile motion, including projectiles launched horizontally and at an angle</p>	<p>SWBAT to calculate the acceleration due to gravity of all objects on Earth using Newton's law of universal gravitation.</p> <p>SWBAT to use Newton's 2nd law of motion and law of universal gravitation to explain, both verbally and mathematically, the relationship and difference between mass and weight.</p> <p>SWBAT make predictions about the position of a projectile at a given point in time using kinematic equations and considering the object's vertical and horizontal motion.</p>	<p>Ball Bounce Predictions: https://danlonghurst.wordpress.com/2012/09/01/first-day-ball-bounce/</p> <p>Reaction Time Ruler-Drop https://www.scienceworld.ca/resource/reaction-time-ruler/</p> <p>Jefferson Lab: Which hits the floor first? https://education.jlab.org/frost/which_hits_the_floor_first.html</p> <p>PHET: Projectile Data Lab https://phet.colorado.edu/en/simulations/projectile-data-lab Simulation: Gravity Force Lab https://phet.colorado.edu/en/simulations/gravity-force-lab-basics Simulation: Projectile Motion https://phet.colorado.edu/en/simulations/projectile-motion</p>

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				ns/projectile-motion
Q4	Momentum	<p>3d. Qualitatively and quantitatively evaluate the relationship among the force acting on an object, the time of interaction and the change in linear momentum</p> <p>3e. Obtain, evaluate, and interpret data related to collisions (both elastic and inelastic) and their effects on both linear momentum and energy conservation</p>	SWBAT to create a device that reduces the impulse experienced by an egg when it hits the ground after being dropped from a height of at least 4 meters.	<p>The Physics Classroom: Collision Carts Interactive https://www.physicsclassroom.com/Physics-Interactives/Momentum-and-Collisions/Collision-Carts/Collision-Carts-Interactive</p>
Q4	Circular Motion	5a. Use mathematics and free-body diagrams to relate tangential velocity, the radius of orbit, the centripetal acceleration, and force to each other for an object moving in a circle		
Q4	Fluids	<p>4a. Plan and carry out experiments to determine the density of objects</p> <p>4b. Use and solve algebraic formulas to determine the relationships between pressure, force, area, and density</p> <p>4c. Design solutions to determine the magnitude and direction of the buoyant force acting on an object</p>		<p>PHET: Simulation: Density https://phet.colorado.edu/en/simulations/density Simulation: Under Pressure https://phet.colorado.edu/en/simulations/under-pressure</p> <p>oPhysics: Buoyancy Simulation https://ophysics.com/fl1.html</p>

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		<p>and the effects</p> <p>4d. Use the buoyant force acting on an object and free body diagrams to determine the acceleration of submerged objects</p>		<p>Science Journal for Teens: Why are flights getting bumpier? https://www.sciencejournalforkids.org/wp-content/uploads/2023/09/turbulenc_e_article.pdf</p>
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