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*MTcxODk4MTUwMS4yNi4xLjE3MTg5ODE5NTIuMzMuMC45MzEzNjY5ODY.
- **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
- **TeachEngingeering.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.
- **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, power, and time	SWBAT calculate work, displacement, force, power, and/or time using equations W = F*d and P = W/t SWBAT explains, both verbally and with images and models, the quantitative relationships among work, force, displacement, power, work, and time. SWBAT calculate input work (input force * input distance) and output work (output force * output distance) in scenarios of simple machines. 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.	Physics Journaling: How do you define “work”? What kinds of things do you consider “work”?
Q1	Energy: Focus on MKE & GPE	3b. Create mathematical and graphical representations to depict the transformation of energy from one form to another, including kinetic energy, gravitational	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	**PHET:** Simulation: Energy Skate Park https://phet.colorado.edu/en/simulations/energy-skate-park

		potential energy, elastic potential energy, and work due to friction 3c. Use models to illustrate the relationship between work performed on an object and the object's total mechanical energy	SWBAT explain, both verbally and with images and models, the conservation and transformation of energy in closed systems SWBAT demonstrates the relationship between work and KE mathematically, verbally, and using various models (online simulations, illustrations, 3D manipulatives, etc.) SWBAT built a complex machine consisting of multiple simple machines that demonstrates transfers and transformations of energy and work done on various objects.	**Podcast:** 99% Invisible–Episode "Curb Cuts" https://99percentinvisible.org/episode/curb-cuts/
Q1 - Q2	Waves: Focus on Sound	7. Obtain, evaluate, and communicate information regarding the propagation, properties, and applications of waves. 7a. Use mathematics and computational thinking to describe the relationship among the velocity, frequency, and wavelength of a propagating wave 7b. Use results of investigations to	SWBAT identifies and calculates the properties of both longitudinal and transverse waves. SWBAT creates models (mathematical, narrative, and illustrated) of wave behaviors when presented with specific phenomena. SWBAT builds a single string instrument, describes how it	**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

		explain the production and characteristics of sound waves including interferences, the Doppler effect, and standing waves 7c. Obtain, evaluate and communicate information to explain the properties and behavior of electromagnetic waves	produces sound waves, and calculates properties of the sound waves it produces.	**oPhysics:** Wave Tutorials and Simulations: https://ophysics.com/w.html **Podcast: Twenty Thousand Hertz** "Sound 101 with Bill Nye" https://www.20k.org/episodes/sound101 **Frontiers for Young Minds:** How long is a note? https://kids.frontiersin.org/articles/10.3389/frym.2023.1094312 Acoustics of Classrooms https://kids.frontiersin.org/articles/10.3389/frym.2022.804634 **Crash Course Physics:** The Physics of Music https://www.youtube.com/watch?v=XDsk6tZX55g
Q2	Electricity	6a. Develop and use a model to describe the mathematical relationship among charge, distance, and force as expressed by Coulomb's law 6b. Obtain, evaluate, and	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.	**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

		communicate information regarding the relationship among voltage, current, and power for direct current circuits 6c. Create models of series, parallel, and mixed direct current circuits 6d. Use mathematics and computational thinking to determine the voltage, current and resistance for an entire circuit and at each resistor or load	SWBAT to construct functioning circuits of various formations using a variety of components. SWBAT to measure the parameters of circuits using multimeters. SWBAT to calculate parameters of circuits using equations defined by Ohm's Law.	Simulation: Ohm's Law https://phet.colorado.edu/en/simulations/ohms-law
Q2 (if time permits)	Intro to vectors			(Use team-building activity with marker and string OR use this for net force)
Q3	Kinematics	1a. Analyze data to create and interpret graphs of position, velocity, and acceleration versus time for one-dimensional motion 1d. Use mathematics and computational thinking to solve problems, using kinematics equations in both one- and	SWBAT creates graphs based on kinematic data collected from measurements taken during in-class experiments. SWBAT makes predictions about objects' position, instantaneous velocity, average velocity, and acceleration using kinematic equations.	**PHET:** Simulation: Vector Addition https://phet.colorado.edu/en/simulations/vector-addition **oPhysics:** Kinematics Simulations https://ophysics.com/k.html

		two-dimensional motion		
Q3	Forces & Motion	2a. Evaluation the effects of balanced and unbalanced forces on an object's motion 2b. Use mathematical, graphical, and narrative methods to explain the relationships among net force, mass, and acceleration of a single object 2c. Create free and fixed body diagrams to model all the forces acting on a single object 2d. Create an explanation of the nature of forces and the interactions among them, including tension, friction, gravitation, and normal forces, using free-body diagrams 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.	SWBAT calculates 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. SWBAT make predictions about individual forces, net forces, objects' mass, and objects' acceleration using the equation $F_{net} = m * a$. SWBAT explains–verbally, mathematically, and through the creation of graphical models–the relationships and interactions among multiple forces acting on an object. SWBAT identifies and distinguishes between balanced forces and force pairs, using Newton's second and third laws.	**PHET** Simulation: Forces & Motion https://phet.colorado.edu/en/simulations/forces-and-motion **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

Q3	Gravity & Projectile Motion	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. 1b. Analyze free fall motion using one-dimensional kinematics to determine the acceleration due to gravity 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	SWBAT to calculate the acceleration due to gravity of all objects on Earth using Newton's law of universal gravitation. 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. SWBAT makes 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.	Ball Bounce Predictions: https://danlonghurst.wordpress.com/2012/09/01/first-day-ball-bounce/ Reaction Time Ruler-Drop https://www.scienceworld.ca/resource/reaction-time-ruler/ **Jefferson Lab:** Which hits the floor first? https://education.jlab.org/frost/which_hits_the_floor_first.html **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
Q4	Momentum	3d. Qualitatively and quantitatively evaluate the relationship among the force acting on an object, the time of interaction and the change in linear momentum	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.	**The Physics Classroom:** Collision Carts Interactive https://www.physicsclassroom.com/Physics-Interactives/Momentum-and-Collisions/Collision-Carts/Collision-Carts-Interactive

		3e. Obtain, evaluate, and interpret data related to collisions (both elastic and inelastic) and their effects on both linear momentum and energy conservation		
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	4a. Plan and carry out experiments to determine the density of objects 4b. Use and solve algebraic formulas to determine the relationships between pressure, force, area, and density 4c. Design solutions to determine the magnitude and direction of the buoyant force acting on an object and the effects 4d. Use the buoyant force acting on an object and free body diagrams to determine the		**PHET:** Simulation: Density https://phet.colorado.edu/en/simulations/density Simulation: Under Pressure https://phet.colorado.edu/en/simulations/under-pressure **oPhysics:** Buoyancy Simulation https://ophysics.com/fl1.html **Science Journal for Teens:** Why are flights getting bumpier? https://www.sciencejournalforkids.org/wp-content/uploads/2023/09/turbulenc

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		acceleration of submerged objects		e_article.pdf