East Penn School District
Curriculum and Instruction

Curriculum for: Physics 1, Applied

Course(s): Applied Physics 1

Grades: 10-12

Department: Science

Length of Period (average minutes): 42

Periods per cycle: 6

Length of Course (yrs): 6

Type of offering: elective

Credit(s) awarded: 1.0 4.0/4.0

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ADOPTED: 2018

Enduring Understandings	Essential Questions	Knowledge	Skills	Standards
• Motion can be described in terms of position, velocity and acceleration. • Motion can be described both algebraically and graphically. • Complex phenomena can be mathematically modeled. • All measurements have uncertainties (no measurement is exact). • Reaction time varies from person to person.	• How can physics knowledge help you to be a safe driver? • How can driving be described using the concepts of position, velocity, and acceleration? • What is the effect of reaction time on driving? • How can something as complicated as the traffic at an intersection be modeled using a limited number of variables? • How are measurements crucial for understanding the motion of a vehicle?	• A person has a measurable reaction time. • Poor reaction time can lead to more accidents. • All measurements have uncertainties or random errors. • Repeated measurements can vary in accuracy and precision. • Random errors can be attributed to the measurement and/or the measuring instrument. • Average velocity = total distance traveled over a given time. • The slope of a displacement vs. time graph is equal to the velocity. • Average velocity = total distance traveled over a given time. • The slope of a velocity vs. time	• Compare methods of finding reaction time • Investigate how distractions affect RT • Calibrate stride length • Identify sources of error • Evaluate estimates of measurements as reasonable or unreasonable. • Define and contrast average and instantaneous speed. • Use strobe photos, graphs, an equation, and motion detector to measure speed. • Graph, interpret, and calculate motion using graphs of motion. • Measure changes in velocity. • Define acceleration using words and an equation.	NGSS Standards: • HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

		graph is equal to the acceleration. ● Braking distance is dependent on the negative acceleration of the vehicle (brakes, road surface) and reaction time.	● Calculate speed, distance, and time using the equation for acceleration. ● Interpret distance-time and velocity-time graphs for different types of motion. ● Plan and carry out an experiment to relate braking distance to speed. ● Examine accelerated motion.	
● What does it mean to say that someone runs faster than someone else? ● How can you increase your speed? ● How can you throw an object further? ● What effect does a shoe have on your sports performance? ● Can you become a world record holder in pole-vaulting by merely purchasing a longer pole?	● A sportscaster requires knowledge of sports as well as language skills and the ability to clearly articulate thoughts and deliver them in an engaging fashion. ● All sports can be explained with the same laws of physics. ● Knowledge of physics can improve sports performance.	● Objects at rest remain at rest and objects in motion remain in motion with a constant velocity along a straight line unless acted upon by an outside force. ● The acceleration of an object is proportional to the net force on it and inversely proportional to its mass. F m= a.	● Apply Newton's first law of motion ● Recognize inertial mass as a physical property of matter ● Use examples to demonstrate that speed is always relative to some other object. ● Explain that the speed of an object depends on the reference frame from which it is being observed. ● Identify the forces acting on an object	NGSS Standards: ● HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

	• The motion of people and objects in sports are governed by Newton's laws using mass, position, velocity and acceleration and forces. • Physics can help explain restrictions to movements in sports. • Sports can be explained in terms of energy transformations.	• Acceleration is a rate of change of velocity. • Velocities and forces add as vectors. • Weight is the force on an object due to the gravitational attraction between that object and Earth. • All objects on Earth fall with the same acceleration due to gravity = 9.8 m/s^2 (if air resistance is ignored). • Newton's third law states that every force has an equal and opposite force. The two forces act on different objects. • Inanimate objects can exert forces. • Friction is a force. The coefficient of friction is a property of the two surfaces in contact and is related to the weight of the object. • Kinetic energy, gravitational potential energy, and spring potential	• Determine when the forces on an object are either balanced or unbalanced • Compare amounts of acceleration semi-quantitatively • Apply Newton's second law of motion • Apply the definition of the newton as a unit of force • Describe weight as the force due to gravity on an object • Apply the terms free fall, projectile, trajectory, and range. • Provide evidence concerning projectiles launched horizontally from the same height at different launch speeds. • Explain the relationship between the vertical and horizontal	

		energy are three forms of energy. ● Energy can be transformed from one form to another, but the energy of a system not acted on by an outside force is conserved.	components of a projectile's motion. ● Recognize factors that affect the range of a projectile. ● Infer the shape of a projectile's trajectory and how it helps sports performance. ● Measure the acceleration due to gravity. ● Use the motion of a real projectile to test a physical model of projectile motion. ● Describe how Newton's third law explains much of the motion in your everyday life. ● Measure the coefficient of sliding friction between a variety of objects.	
● Not all accidents can be prevented but you can ensure that an accident is less severe for a driver, a	● How do Newton's laws relate to automobile safety?	● Many safety features have been added to automobiles such as seat belts, head	● Evaluate your understanding of safety ● Identify and evaluate safety	NGSS Standards: ● HS-ETS1-2. Design a solution to a complex real-world problem by

passenger and a pedestrian. ● Physical laws can describe and predict what will occur during an accident. ● Safety measures based on physics principles can protect you during an accident. ● Seat belts, air bags, headrests and other technologies are based on physics principles. ● Accidents can be analyzed by using physics principles.	● How do seat belts, airbags, headrests, collapsible steering columns and other safety devices protect you? ● How can people reconstruct an accident after it has taken place to determine liability? ● What is the law of conservation of momentum? ● What physics principles would you take into account if you were designing a safety device for a bicycle or motorcycle?	restraints, airbags, crumple zones, etc. ● Newton's first law states that an object in motion will stay in motion unless acted upon by a force. If your vehicle stops suddenly, you continue to travel forward. ● Pressure is defined as the force per unit area. A seat belt made from a wire could slice through your body, while a seat belt of wide cloth will stop you without much pressure. ● A moving object has kinetic energy. To change that KE, there must be work (a force applied over a distance. To stop someone during an accident requires a certain amount of work. The person can be stopped with a large force over a very short distance or a small force over a larger distance.	features in selected automobiles ● Compare and contrast the safety features in select automobiles ● Identify safety features required for other modes of transportation ● Describe the role of seatbelts ● Express the relationship between pressure, force, and area. ● Model an automobile airbag ● Relate the energy of a moving object to the work required to stop the object ● Demonstrate an understanding about the relationship between the force of an impact and the stopping distance ● Conduct analyses of the momentum pairs of objects in	breaking it down into smaller, more manageable problems that can be solved through engineering. ● HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. ● HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. ● HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and

		Cushioned dashboards and air bags are used to lengthen the distance over which the smaller force can bring you to a halt. ● A driver hit from behind will experience whiplash. This is where the head moves back and then snaps forward. Whiplash can be explained using Newton's first law and Newton's second laws. ● When two moving vehicles collide, the change in motion depends upon the relative masses of the vehicles. This is described in terms of the momentum of the vehicles. ● In all collisions, the total momentum before the collision is equal to the total momentum after the collision. This law of the conservation of momentum is true of collisions from	one-dimensional collisions. ● Understand and apply the law of conservation of momentum to collisions ● Measure the momentum before and after a moving mass strikes a stationary mass in a head-on collision ● Describe collisions and crumple zones in terms of momentum , impulse, and force ● Explore ways of using cushions to increase the time that a force acts during a primary collision	refine a device that minimizes the force on a macroscopic object during a collision. ● HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. ● HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). ● HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

		planets to microscopic particles. ● The total momentum in a collision is conserved but the momentum of each vehicle can change. The change in momentum is equal to the force applied over a given time.		
● Amusement park rides are physics laboratories where safety and thrills are both desired. - The height and speeds of roller coasters can all be calculated. - Roller-coaster designers take into account physics principles. - The thrills of a roller-coaster ride are not linked to speed but to changes in speed. - Roller-coaster rides can be analyzed using forces and/or energy principles.	● How can energy conservation be used to calculate the speed of the roller coaster at all points? ● Where does weight come from? What is the universal law of gravitation? ● How much apparent weight change do we experience during a roller-coaster ride? ● How are forces responsible for the thrills of a roller-coaster ride?	● A three-dimensional roller coaster can be depicted using a side view and a top view diagram. ● Changes in velocity with respect to time (accelerations) are responsible for the thrills of a roller coaster. ● Gravitational potential energy: GPE = mgh ● Kinetic energy is the energy of motion. ● Spring potential energy is the energy in a compressed or expanded spring. ● The sum of all energies in a roller	● Identify that “thrills” come from changes in velocity. ● Define the equation for acceleration and apply it to a variety of situations. ● Apply the interplay between GPE and KE to a roller-coaster ride. ● State and conservation of energy and relate it to a roller-coaster ride. ● Use Hooke’s Law to find the weight of an object.	NGSS Standards: ● HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. ● HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

- Safety issues are linked to physics calculations and are crucially important in designing a roller-coaster ride.	● Where does the energy originate for a rollercoaster ride? ● How are forces and energy related?	coaster is identical at all places on the roller coaster. ● The force of gravitational attraction between any two masses can be calculated using Newton's law. ● Work applied to a coaster can increase the gravitational potential energy. W 5 Fd ● Power is the rate of doing work. ● Energy and force are related through work. ● Safe roller coasters do not exceed an acceleration of 4 g. This acceleration must be calculated at all curves on the roller coaster	● Measure the effect of weight on the vertical stretch of a spring and its relation to the motion on a roller coaster. ● Identify how accelerations during a roller-coaster ride affect the apparent weight of the passengers. ● Predict mathematically the change in apparent weight as a mass accelerates up or down. ● Use the definition of Work and Power as they apply to a roller coaster. ● Describe a roller-coaster ride using the physics principles of energy conservation and forces.	● HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. ● HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. ● HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). ● HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

● Music, theater, movies and concerts are filled with auditory and visual effects that can be explained using some basic physics principles. Appreciation for the arts can be enhanced by an appreciation of the physics principles behind the art. - All musical sounds can be modeled with the concept of standing waves on strings and in air columns and on surfaces. - Light and vision allows us to create all sorts of images. - Physics principles can be adapted by engineers to create technologies such as mirrors and lenses. - Shadows and color are additional optical effects that can productively be used in art when they are understood.	● How can a vibrating string produce sound? ● How can an air column produce sound? ● How can different pitch sounds be produced by strings and wind instruments? ● How do mirrors produce images? ● How do lenses produce images? ● How can we use color and shadows to create an exciting visual display? ● How can sound and light be used to create an entertaining show?	● The frequency of a vibrating string can be increased by shortening the string or increasing its tension. ● As the length of an air column increases, there is a decrease in the frequency produced. ● Standing waves (transverse and longitudinal) can be set up on strings or air columns producing specific frequencies of sound. ● Light travels in straight lines. If an opaque object is placed in the path, the object will form a shadow. ● When light reflects off a mirror, the angle of incidence is equal to the angle of reflection (law of reflection). ● The law of reflection can explain why a plane mirror produces images which are the same	● Observe the effect of string length on the pitch of the sound produced. ● Observe the effect of tension on the pitch of the sound produced. ● Control the variables of length and tension on a vibrating string. ● Observe and calculate the motion of a wave pulse. ● Observe and identify standing waves and their patterns. ● Investigate the relationship among wave speed, wavelength, and frequency. ● Distinguish between transverse and longitudinal waves. ● Observe how pitch changes with tube length. ● Observe the effect of closing one end of the tube.	NGSS Standards: ● HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. ● HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

		size as the object and also why concave and convex mirrors can produce larger and smaller images. ● Light traveling from one medium to another changes speed and can refract (bend) as it enters the new medium. ● A lens is shaped so as to have all parallel rays of light converge at a single point—the focal point. ● An image is formed when the light from an object travels through a lens. The image can be larger or smaller than the object. ● Colors that you see are due to reflected light.	● Relate observations of pitch to drawings of standing waves. ● Observe the reflection of light by a plane and curved mirror. ● Identify the normal of a plane mirror ● Measure angles of incidence and reflection for a plane and curved mirror. ● Collect evidence to support the Law of Reflection. ● Create and observe real and virtual images in plane, convex, and concave mirrors.	

Materials and Resources:
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