Randolph Township Schools
Randolph High School

AP Physics 1 Curriculum

"Mathematical physics is in the first place physics and it could not exist without experimental investigations."
- Peter Bebye

Department of
Science, Technology, Engineering, and Mathematics
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Board APPROVAL
September 8, 2015

Randolph Township Schools

Department of Social Studies
Physics and Engineering

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Randolph Township Schools

Mission Statement

We commit to inspiring and empowering all students in Randolph schools to reach their full potential as unique, responsible and educated members of a global society.

Randolph Township Schools
Affirmative Action Statement

Equality and Equity in Curriculum

The Randolph Township School district ensures that the district's curriculum and instruction are aligned to the state's standards. The curriculum provides equity in instruction, educational programs and provides all students the opportunity to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, religion, disability or socioeconomic status.

N.J.A.C. 6A:7-1.7(b): Section 504, Rehabilitation Act of 1973; N.J.S.A. 10:5; Title IX, Education Amendments of 1972

RANDOLPH TOWNSHIP BOARD OF EDUCATION
EDUCATIONAL GOALS
VALUES IN EDUCATION

The statements represent the beliefs and values regarding our educational system. Education is the key to self-actualization, which is realized through achievement and self-respect. We believe our entire system must not only represent these values, but also demonstrate them in all that we do as a school system.

We believe:

- The needs of the child come first
- Mutual respect and trust are the cornerstones of a learning community
- The learning community consists of students, educators, parents, administrators, educational support personnel, the community and Board of Education members
- A successful learning community communicates honestly and openly in a non-threatening environment
- Members of our learning community have different needs at different times. There is openness to the challenge of meeting those needs in professional and supportive ways
- Assessment of professionals (i.e., educators, administrators and educational support personnel) is a dynamic process that requires review and revision based on evolving research, practices and experiences
- Development of desired capabilities comes in stages and is achieved through hard work, reflection and ongoing growth

Randolph Township Schools
Department of Science, Technology, Engineering, and Math

Introduction

Randolph Township Schools is committed to excellence. We believe that all children are entitled to an education that will equip them to become productive citizens of the 21st century. We believe that an education grounded in the fundamental principles of science, technology, engineering, and math (STEM) will provide students with the skills and content necessary to become future leaders and lifelong learners.

A sound STEM education is grounded in the principles of inquiry, rigor, and relevance. Students will be actively engaged in learning as they use real-world STEM skills to construct knowledge. They will have ample opportunities to manipulate materials and solve problems in ways that are developmentally appropriate to their age. They will work in an environment that encourages them to take risks, think critically, build models, observe patterns, and recognize anomalies in those patterns. Students will be encouraged to ask questions, not just the "how" and the "what" of observed phenomena, but also the "why". They will develop the ability, confidence, and motivation to succeed academically and personally.

STEM literacy requires understandings and habits of mind that enable students to make sense of how our world works. As described in Project 2061's *Benchmarks in Science Literacy, The Standards for Technological Literacy,* and *Professional Standards for Teaching Mathematics,* literacy in these subject areas enables people to think critically and independently. Scientifically and technologically literate citizens deal sensibly with problems that involve mathematics, evidence, patterns, logical arguments, uncertainty, and problem-solving.

AP Physics 1: Physics

Introduction

This course is an introductory course equivalent to a first semester college course in algebra based physics. In this course students will:

- Understand the basic laws governing the universe and apply them to engineering design problems
- Build critical thinking and problem solving skills
- Apply the problem-solving design loop to a wide range of engineering problems
- Solve problems through labs and hands-on projects that reinforce skills in the areas of:
    - Kinematics
    - Newtonian Mechanics
    - Rotational Dynamics
    - Energy
    - Waves and Sound
    - Electrical Circuits

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
AP Physics 1

SUGGESTED TIME ALLOTMENT	UNIT NUMBER	CONTENT - UNIT OF STUDY
0.5 weeks	I	Vectors
5 weeks	II	Kinematics and Projectile Motion
5 weeks	III	Newton's Laws
3 weeks	IV	Momentum
1 weeks	V	Universal Gravitation
3 weeks	IV	Circular Motion
5 week s	VII	Center of Gravity and Rotational Mechanics
4 weeks	VIII	Energy
2 weeks	IX	Mechanical Waves and Sound
2 weeks	X	Electrical Circuits
1.5 weeks	XI	Putting it all together (AP Exam Review)
4	XII	Projects (After AP Test)

RANDOLPH TOWNSHIP SCHOOL DISTRICT
AP Physics 1
UNIT I: Vectors

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Units are a key part of measuring.	• What would happen if every distance were measured in the same unit?
Vectors describe magnitude and direction and scalars describe just magnitude.	• How do you calculate your velocity when running a complete loop around a track? How do you calculate your speed when running a complete loop around a track? Explain the difference.
Significant Figures reflect known and estimated digits in a measurement.	• What would happen to a measurement if significant figures were disregarded?

KNOWLEDGE	SKILLS	NJCCCS
Students will know:	**Students will be able to:**	
The rules for unit conversions.	Apply unit conversion rules effectively to help in problem solving.	5.2.8.E.2 5.1.12.A.1 5.1.12.A.2 5.1.12.A.3 5.1.12.B.1 5.1.12.B.2 5.1.12.B.3 5.1.12.B.4 5.1.12.D.1 5.1.12.D.2 ELA-Literacy.RST.11-12.3 ELA-Literacy.RST.11-12.4 ELA-Literacy.RST.11-12.8
	Identify appropriate units for specific measurements.	
Any vector can be decomposed into horizontal and vertical components.	Apply trigonometric functions to decompose vectors into horizontal and vertical components.	
How to add vectors of various orientation to find a resultant vector.	Use trigonometric functions to solve vectors addition problems.	
The difference between “displacement and distance” and “velocity and speed.”	Distinguish between vectors and scalars.	
Rules for keeping significant figures.	Evaluate the reasonableness of their answer based on an initial estimation.	
	Apply rules for significant figures to keep an answer as accurate as the initial values given.	

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
AP Physics 1

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
0.5 weeks	**Unit I - Vectors** o Significant Figures o Units and Unit Conversions o Vectors and Scalars o Vector Addition	SUPPLIES: Meter Sticks Stop Watches Rulers Protractor

RANDOLPH TOWNSHIP SCHOOL DISTRICT
AP Physics 1
UNIT II: Kinematics and Projectile Motion

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Motion is relative and can be described differently based on an observer's frame of reference.	• Explain why it may appear that you are traveling in reverse when a car passes you on the highway.
Motion is predictable and can be described mathematically.	• What possible variables could you change and in what ways can you change them in order to increase the displacement of a trip?
The slope of a displacement vs. time graph is the instantaneous speed at that position.	• What is the importance of the slope of a velocity vs. time graph?

KNOWLEDGE	SKILLS	NJCCCS
Students will know:	**Students will be able to:**	
Constant motion means no acceleration.	Design a procedure that will allow the student to predict the collision location of a constant velocity buggy driving up a hill and a ball rolling down from the top of the hill.	5.2.12.E.1 5.2.12.E.2 5.1.12.A.1 5.1.12.A.2 5.1.12.A.3 5.1.12.B.1 5.1.12.B.2 5.1.12.B.3 5.1.12.B.4 5.1.12.D.1 5.1.12.D.2 ELA-Literacy.RST.11-12.3 ELA-Literacy.RST.11-12.4 ELA-Literacy.RST.11-12.8
The significance of acceleration.	Graph the motion of an accelerating object and interpret the graph.	
All objects fall at the same rate when air resistance is not a factor.	Design an experiment that will test the free fall rates of various masses.	
A frame of reference is a way of comparing two things in motion.	Explain velocities in differing frames of reference.	
All of the equations of motion and where they came from.	Apply equations of motion to solve problems of predicting motion.	
Any given displacement is made up of a combination of independent horizontal and vertical displacements.	Apply trigonometric functions to decompose a vector into vertical and horizontal components.	
Projectile motion is a series of velocity vectors resulting from an accelerating vertical velocity and a constant horizontal velocity.	Solve problems involving projectile motion.	

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
AP Physics 1

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
5 weeks	**Unit II – Kinematics and Projectile Motion** ○ Constant Motion ○ 1-Dimensional Acceleration Motion ○ Freefall ○ 2-Dimensional Motion ○ Projectile Motion	www.Phet.colorado.edu (online physics simulation labs) zSpace - http://zspace.com/ SUPPLIES: Meter Sticks Stop Watches Rulers Constant velocity Buggy Vernier Motion Detectors MacBooks/PCs Crash Cart tracks Bowling Ball Tennis Ball

RANDOLPH TOWNSHIP SCHOOL DISTRICT
AP Physics 1
UNIT III: Newton's Laws

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Newton's 1st Law: Objects in motion will stay in motion and objects at rest will stay at rest, unless acted upon by an outside force.	• Explain how something can have no forces acting on it, yet still be moving.
Newton's Second Law: Force is equal to the product of mass and acceleration.	• If two cars of different masses had the same exact engine, which one would you want to buy and why?
Newton's Third Law: For every force there is an equal and opposite reaction force.	• If they both feel an equal and opposite force, why is a car not affected as much as a fly when they collide?

KNOWLEDGE	SKILLS	NJCCCS
Students will know:	**Students will be able to:**	
Inertia is a property of matter.	Predict motions of an object due to its inertia.	5.2.12.E.3 5.2.12.E.4
Newton's first law.	Explain why objects move in the direction predicted by Newton's 1st Law.	5.1.12.A.1 5.1.12.A.2 5.1.12.A.3
Newton's second law.	Predict motion of an object based on the force applied to it.	5.1.12.B.1 5.1.12.B.2
Weight is a force resulting from a mass experiencing acceleration.	Explain the difference between weight and mass. Predict an objects weight on other planets	5.1.12.B.3 5.1.12.B.4 5.1.12.D.1
Forces can be represented by vectors and treated as such.	Analyze free body diagrams to solve problems.	5.1.12.D.2 ELA-Literacy.RST.11-12.3
Friction is an opposing force and it is caused by two surfaces rubbing together.	Calculate friction and identify in the lab variables that affect it.	ELA-Literacy.RST.11-12.4
Newton's third law.	Explain why reaction forces do not cancel the initial action force. Explain how to determine the acceleration of an Atwoods machine setup.	ELA-Literacy.RST.11-12.8

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
AP Physics 1

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
5 weeks	**Unit III – Newton's Laws** ○ First Law: Inertia and Mass ○ Second Law: F=ma ○ Free Body Diagrams ○ Incline Plane Problems ○ Third Law: Action/ Reaction ○ Pulley Problems ○ Elevator problems	www.Phet.colorado.edu (online physics simulation labs) www.Physicsclassroom.com (short animated clips as demonstrations) zSpace - http://zspace.com/ SUPPLIES: Meter Sticks Stop Watches Rulers Constant velocity Buggy Vernier Motion Detectors MacBooks/PCs Crash Cart tracks Bowling Ball Tennis Ball Hooked Masses Momentum Carts Hammer Pie Plate Place Setting Broom Friction Blocks Pulleys Vernier Probes Vernier Software

RANDOLPH TOWNSHIP SCHOOL DISTRICT
AP Physics 1
UNIT IV: Momentum

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
A closed system is not affected by anything outside the system.	• What are some ways that the Earth is a closed system? What are some ways that the Earth is an open system? Explain why the two are different.
Impulse is the change in momentum and is a derivation from Newton's Second Law.	• How do airbags work to keep you safe in a collision?
Momentum of a closed system is always conserved.	• What would happen if a gun had the same mass as the bullet inside of it?

KNOWLEDGE	SKILLS	NJCCCS
Students will know: Momentum is Inertia in motion. A force is required to change momentum. The various types of collisions, and identify the implications of each collision. The total momentum of a given system is always conserved, even in 2-dimensions.	**Students will be able to:** Determine the momentum of objects. Calculate the impulse needed and predict the force required to change the momentum of an object. Analyze a collision and determine the initial conditions of each object. Predict motions of objects after a given collision, including 2-dimension collisions.	5.2.12.D.4 5.2.12.E.3 5.2.12.E.4 5.1.12.A.1 5.1.12.A.2 5.1.12.A.3 5.1.12.B.1 5.1.12.B.2 5.1.12.B.3 5.1.12.B.4 5.1.12.D.1 5.1.12.D.2 ELA-Literacy.RST.11-12.3 ELA-Literacy.RST.11-12.4 ELA-Literacy.RST.11-12.8

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
AP Physics 1

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
3 weeks	**Unit IV – Momentum** ○ Momentum ○ Impulse ○ Conservation of Momentum ○ Explosions ○ Elastic Collisions ○ Inelastic Collisions ○ 2-D Collisions	www.Phet.colorado.edu (online physics simulation labs) www.Physicsclassroom.com (short animated clips as demonstrations) zSpace - http://zspace.com/ SUPPLIES: Meter Sticks Stop Watches Rulers Constant velocity Buggy Vernier Motion Detectors MacBooks/PCs Crash Cart tracks Bowling Ball Tennis Ball Hooked Masses Momentum Carts Hammer Pie Plate Place Setting Broom Friction Blocks Pulleys Vernier Probes Vernier Software Egg Drop Supplies

RANDOLPH TOWNSHIP SCHOOL DISTRICT
AP Physics 1
UNIT V: Universal Gravitation

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Everything that has mass is attracted to every other object with mass no matter how far away.	• How do planets stay in orbit? • How do you think planets formed in the early universe?
Force of attraction gets weaker as distance increases.	• Why are we "stuck" to the earth, even though the sun is much more massive?

KNOWLEDGE	SKILLS	NJCCCS
Students will know: Masses are attracted to one another. Things in orbit are actually in freefall. Gravitational force is inversely proportional to the square of the distance between the two masses. How the gravitational force of the moon creates tides. The importance gravitational forces have in shaping the universe.	**Students will be able to:** Calculate the force of gravitational attraction between themselves and a friend. Explain why they observe apples falling and the moon orbiting. Derive the value of the earth's gravitational acceleration, $g = 9.8 m/s^2$. Compare the effects of the moon and the sun on the ocean tides. Predict what would happen if a new planet were to "pop" into our solar system.	5.2.12.E.3 5.2.12.E.4 5.1.12.A.1 5.1.12.A.2 5.1.12.A.3 5.1.12.B.1 5.1.12.B.2 5.1.12.B.3 5.1.12.B.4 5.1.12.D.1 5.1.12.D.2 ELA-Literacy.RST.11-12.3 ELA-Literacy.RST.11-12.4 ELA-Literacy.RST.11-12.7 ELA-Literacy.RST.11-12.8

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
AP Physics 1

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
1 weeks	**Unit V – Universal Gravitation** ○ Law of Gravitation ○ Calculating force of attraction between 2 masses ○ Law of attraction with planets ○ Comparing forces and accelerations on different planets	www.Phet.colorado.edu (online physics simulation labs) www.Physicsclassroom.com (short animated clips as demonstrations) SUPPLIES: Meter Sticks Stop Watches Rulers Vernier Motion Detectors MacBooks/PCs Vernier Probes Vernier Software

RANDOLPH TOWNSHIP SCHOOL DISTRICT
AP Physics 1
UNIT VI: Circular Motion

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Circular motion means revolutions not rotations.	• Give examples of things that revolve and things that rotate. What are the differences?
Period is the time it takes to complete one orbit, frequency is the number of orbits per second.	• What would happen if we did not have a leap year every 4 years and just had 365 days every year?
The force that is felt in circular motion is centripetal. Centrifugal force is not a real force.	• Why does the moon not come crashing into the Earth? • How could you create artificial gravity in a spaceship?

KNOWLEDGE	SKILLS	NJCCCS
Students will know:	**Students will be able to:**	
The difference between a rotation and a revolution.	Observe an object in motion and explain why it is revolving or rotating.	5.2.12.E.3 5.2.12.E.4 5.1.12.A.1
For an object to move in a circle there must be Acceleration and Force acting on the object.	Draw Free Body Diagrams of the forces acting on objects in circular motion and predict their motions.	5.1.12.A.2 5.1.12.A.3 5.1.12.B.1
Newton's 2nd Law still holds true for centripetal force and centripetal acceleration.	Apply universal gravitation and circular motion to predict masses of mystery planets.	5.1.12.B.2 5.1.12.B.3 5.1.12.B.4
The relationship between the frequency, period, and force of an object moving in a circular motion.	Create a lab that will measure the coefficient of friction between a penny and a turntable using circular motion.	5.1.12.D.1 5.1.12.D.2
	Calculate the frequency and period of the penny in the above lab.	ELA-Literacy.RST.11-12.3 ELA-Literacy.RST.11-12.4
The effects of centripetal force in a rotating system can feel like gravity.	Design a spacecraft that would have the appropriate parameters so that astronauts on board would experience an "Earth-like" artificial gravity.	ELA-Literacy.RST.11-12.7 ELA-Literacy.RST.11-12.8

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
AP Physics 1

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
3 weeks	**Unit VI – Circular Motion** ○ Properties of Circular Motion ○ Rotation/Revolution ○ Period/Frequency ○ Centripetal/Tangential ○ Formulas that apply ○ Orbital problems relating back to universal gravity ○ Lab Activities with flying pigs and planes traveling in consistent circle	www.Phet.colorado.edu (online physics simulation labs) www.Physicsclassroom.com (short animated clips as demonstrations) zSpace - http://zspace.com/ Rubric for Lab Creation and Spacecraft Design – to be developed. SUPPLIES: Meter Sticks Stop Watches Rulers Constant velocity Buggy Vernier Motion Detectors MacBooks/PCs Pulleys Vernier Probes Vernier Software Flying Pigs on String Flying airplanes on string

RANDOLPH TOWNSHIP SCHOOL DISTRICT
AP Physics 1
UNIT VII: Center of gravity and Rotational Mechanics

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
A structure will stand if its center of gravity is located anywhere directly above part of its base.	• Why do animals that walk on two legs have larger feet than those that walk on four legs?
The structure of an object affects its rotational inertia.	• Why does a figure skater pull her arms and legs very tight to her body when going into a spin, and then extend her arms and legs outward away from her body after the spin is over? • If you were to walk across a tight rope, what are some ways you could increase your chances of not falling off?
Angular momentum is the product of angular speed and rotational inertia.	• What are the pros and cons of putting very large tires on your car?

KNOWLEDGE	SKILLS	NJCCCS
Students will know:	**Students will be able to:**	
The role that center of gravity plays in the construction of a device.	Find the center of gravity of a given structure.	5.2.12.E.3 5.2.12.E.4
	Evaluate the stability of a structure based on its center of gravity.	5.1.12.A.1 5.1.12.A.2
Torque is not a force but it is determined by a force.	Calculate the torque on an object.	5.1.12.A.3 5.1.12.B.1
To be in equilibrium, the net torque on an object must be zero.	Create a system in rotational equilibrium by placing varying masses at appropriate locations.	5.1.12.B.2 5.1.12.B.3 5.1.12.B.4
All objects have rotational inertia as well as linear inertia.	Hypothesize and conclude what happens to a freely spinning person with arms tucked in, then arms extended out.	5.1.12.D.1 5.1.12.D.2
Angular momentum is conserved just as linear momentum is.	Predict qualitatively how the angular momentum will change by varying the angular speed and rotational inertia.	ELA-Literacy.RST.11-12.3 ELA-Literacy.RST.11-12.4 ELA-Literacy.RST.11-12.8

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
AP Physics 1

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES

5 weeks	**Unit VII – Center of Gravity and Rotational Mechanics**
	o Center of Gravity
	  o How to find it
	  o How are structures built stable based on center of gravity
	o Torque
	  o How is it calculated
	  o How does it effect rotational motion
	o Rotational Inertia and Angular Momentum
	  o How to calculate rotational inertia for different objects
	  o How does rotational mechanics effect linear mechanics of rolling objects
		www.Phet.colorado.edu (online physics simulation labs)
		
		www.Physicsclassroom.com (short animated clips as demonstrations)
		
		zSpace - http://zspace.com/
		
		SUPPLIES:
		Meter Sticks
		Stop Watches
		Rulers
		Constant velocity Buggy
		Vernier Motion Detectors
		MacBooks/Pcs
		Pulleys
		Vernier Probes
		Vernier Software
		Jenga
		Rotational dynamics kit
		Spheres, disks, cylinders
		Rotating chair or platform

RANDOLPH TOWNSHIP SCHOOL DISTRICT
AP Physics 1
UNIT VIII: Work, Power and Energy

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Energy can come in various forms and it can be transferred from one form to another when work is done.	• What are examples of systems that convert mechanical energy from one form to another?
The amount of energy before a transformation is equal to the amount of energy after the transformation.	• Explain the transfer of energy in a roller coaster? • In the real world, can a machine ever be 100% efficient? Why?

KNOWLEDGE	SKILLS	NJCCCS
Students will know:	**Students will be able to:**	
Work is the product of Force and displacement.	Calculate work done on objects in motion.	5.2.12.D.1 5.2.12.D.4
Power is Work done over a time interval.	Calculate their own power output based on how fast they can climb up the stairs.	5.1.12.A.1 5.1.12.A.2 5.1.12.A.3
There are various forms of energy and energy can be transferred from one form to another.	Differentiate between forms of energy.	5.1.12.B.1 5.1.12.B.2 5.1.12.B.3
Energy can never be created or destroyed, only transferred.	Solve problems using conservation of energy.	5.1.12.B.4 5.1.12.D.1
In a closed system the total mechanical energy will always remain constant.	Design a rollercoaster that will have no energy input other than its initial climb up the first hill.	5.1.12.D.2 ELA-Literacy.RST.11-12.3
Any energy lost due to friction will be equal to the work done by friction on the system.	Evaluate many proposed perpetual motion devices and explain why they would not be effective.	ELA-Literacy.RST.11-12.4 ELA-Literacy.RST.11-12.7

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
AP Physics 1

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
4 weeks	**Unit VIII – Energy** ○ Work ○ How to calculate it ○ Identify work or no work ○ Power ○ How is it calculated ○ People Power Lab ○ Energy ○ Types of energy ○ How each one is calculated ○ Conservation of Energy ○ Falling masses ○ Roller Coasters ○ Bow and Arrow problems	www.Phet.colorado.edu (online physics simulation labs) www.Physicsclassroom.com (short animated clips as demonstrations) zSpace - http://zspace.com/ SUPPLIES: Meter Sticks Stop Watches Rulers Constant velocity Buggy Vernier Motion Detectors MacBooks/PCs Pulleys Vernier Probes Vernier Software Frictionless Carts Masses K'Nex Roller coaster kit Rubber Bands Hooke's Law apparatus

RANDOLPH TOWNSHIP SCHOOL DISTRICT
AP Physics 1
UNIT IX: Mechanical Waves and Sound (excluding light)

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Waves carry energy through a medium. The energy is transmitted, not the matter of the medium.	• How does changing the medium that a wave is traveling in affect the properties of the wave? Use examples.
Wave interference can create a phenomenon known as resonance.	• Why is it important for resonance be taken into account when engineering a structure such as a bridge or a building?
Doppler effect is created when the source of a wave is in motion.	• How can your frame of reference affect how you experience a wave?

KNOWLEDGE	SKILLS	NJCCCS
Students will know:	**Students will be able to:**	
All the properties of a wave and how they affect the wave.	Draw a sine wave and label all the components and characteristics.	5.2.12.E.1 5.2.12.E.2
Waves come in various categories (transverse, longitudinal, transmission).	Distinguish between the various wave types.	5.1.12.A.1 5.1.12.A.2 5.1.12.A.3
The difference between wave speed and frequency.	Calculate values of wave velocity, frequency and wavelength.	5.1.12.B.1 5.1.12.B.2
How the medium a wave is traveling in will affect the properties of the wave.	Create transverse, longitudinal and standing waves using a slinky.	5.1.12.B.3 5.1.12.B.4
Frequency is what determines a sounds pitch and humans can only hear a certain range of frequencies.	Compare various instruments and the properties of the sound waves they each produce.	5.1.12.D.1 5.1.12.D.2 ELA-Literacy.RST.11-12.3
Objects vibrate at their own natural frequency based on size, shape, and material.	Build musical instruments out of PVC piping that can play a variety of pitches.	ELA-Literacy.RST.11-12.4
How one perceives a wave's speed could affect the way they perceive the frequency.	Discuss and explain the reason the siren of a police car sounds the way it does when it passes you.	

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
AP Physics 1

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
2 weeks	**Unit IX – Mechanical Waves and Sound (excluding light)** ○ Properties of Waves ○ What are waves ○ What are the components of a wave ○ Wave characteristics ○ How do waves act ○ How do waves interact ○ Resonance ○ Sound ○ How do the components of waves effect sound ○ How does the make-up of a material determine the types of sound it can create ○ Doppler Effect	www.Phet.colorado.edu (online physics simulation labs) www.Physicsclassroom.com (short animated clips as demonstrations) zSpace - http://zspace.com/ Video: Tacoma Narrows Bridge Collapse SUPPLIES: Meter Sticks Stop Watches Rulers Constant velocity Buggy Vernier Motion Detectors MacBooks/PCs Pulleys Vernier Probes Vernier Software Tuning Forks Slinkies Jump Rope Cymbals

RANDOLPH TOWNSHIP SCHOOL DISTRICT
AP Physics 1
UNIT X: Electricity

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Electric charge is a property of an object or system that affects its interactions with other objects or systems containing charge. Opposite charges attract and like charges repel.	• How does Coulomb's Law for charged objects compare to Newton's Law of universal gravitation?
Electricity is a form of energy that can be transformed by moving electric charges doing work in various devices.	• How do the properties of electrostatics lead to creating and harnessing electric energy?
A potential difference has to be maintained in order to move charges between two points.	• How is it possible for a bird to sit on a high voltage wire without being electrocuted?

KNOWLEDGE	SKILLS	NJCCCS
Students will know:	**Students will be able to:**	
There are only two types of electrical charges: positive and negative.	Distinguish between the properties of protons and electrons.	5.2.12.A.1 5.2.12.B.1 5.1.12.A.1 5.1.12.A.2 5.1.12.A.3 5.1.12.B.1 5.1.12.B.2 5.1.12.B.3 5.1.12.B.4 5.1.12.D.1 5.1.12.D.2 ELA-Literacy.RST.11-12.3 ELA-Literacy.RST.11-12.4
Like charges repel and opposite charges attract.	Predict the motions of charged particles.	
Coulomb's Law.	Calculate the force between two charges using Coulomb's Law.	
Current is the flow of electrons through a wire.	Measure the current in a circuit.	
What a short circuit is and the affects it has.	Predict the affects of attaching a single wire from positive to negative on a car battery.	
What a resistor is and how it affects current in a circuit.	Measure and calculate resistance in a circuit.	
	Calculate the resistance of a wire.	
	Build simple circuits and analyze its variables (e.g., total resistance, current, voltage drop and power).	
	Use multi-meters to confirm values of circuit variables.	

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
AP Physics 1

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
2 weeks	**Unit X – Electricity** o Properties of Charge o What is Charge o How do charges interact o Coulomb's Law o Calculate Forces between Charges o Measure work done on a charge due to another charge o Circuits o What is current and how is it measured o Properties of current and how a circuit works o Resistance in a circuit and how it effects other parameters	www.Phet.colorado.edu (online physics simulation labs) www.Physicsclassroom.com (short animated clips as demonstrations) zSpace - http://zspace.com/ SUPPLIES: Meter Sticks Stop Watches Rulers Constant velocity Buggy Vernier Motion Detectors MacBooks/PCs Pulleys Vernier Probes Vernier Software Snap Circuit Kits Power Supplies Multi-Meters Wires Light Bulbs

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AP Physics 1
UNIT VII: Projects

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
• Technology products and innovations often utilize physics.	• How is physics involved in the design of technology products?

KNOWLEDGE	SKILLS	CCSS
Students will know: How knowledge of physics is helpful (and sometimes necessary) for utilizing and improving technology.	**Students will be able to:** Research a physics related technology topic. Prepare and deliver a presentation on the chosen topic and the impact of physics on this topic. Properly cite sources for written material and other media used in presentation. Prepare an authentic lab for your classmates to do that will illustrate one or more of the physics concepts which are incorporated in the design and utilization of the technology topic selected.	5.1.12 5.2.12.A.1, 2, 4 5.2.12.D.1m 4 5.2.12.E.1, 2, 3 ELA-Literacy.WHST.11-12.2 ELA-Literacy.WHST.11-12.4 ELA-Literacy.WHST.11-12.6 ELA-Literacy.WHST.11-12.8 ELA-Literacy.RST.11-12.3 ELA-Literacy.RST.11-12.4 ELA-Literacy.RST.11-12.5 ELA-Literacy.RST.11-12.10

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UNIT XII: Projects after AP Exam

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
4 Weeks	Unit XII: Projects after AP Exam 1) Select Physics topics 2) Research topic 3) Prepare and deliver presentation.	All supplemental unit resources included in units I through XI. Presentation Rubric – to be developed.

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AP Physics 1

APPENDIX A

Resources:

Textbook:

Physics: Principles with Applications 5th Ed
Author: Giancoli, Douglas C.
ISBN-13: 978-0136119715
Copyright 2002 Prentice Hall

Book of additional word problems:

Problem-Solving Exercises in Physics
Author: Hickman, Jennifer Bond
ISBN: 0-201-24758-5
Copyright 1991 Addison-Wesley Publishing Company, Inc

Technology

Various Vernier software and sensors

Web Sites

Virtual Labs: www.Phet.colorado.edu
Online physics tutorial: www.physicsclassroom.com

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APPENDIX B

ASSESSMENT:

- Quizzes
- Tests
- Individual Projects
- Group Projects
- Homework
- Labs

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AP Physics 1

APPENDIX C

Opportunities exist for interdisciplinary units with courses such as Algebra II, Calculus, Trigonometry and Environmental Science.

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APPENDIX D

It is assumed that the student has successfully completed Algebra IA, and four semesters of a Science.

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APPENDIX E

Lesson plans to follow as curriculum is implemented.