Course Title: Physics
Board Approval Date: January 19, 2015
Credit / Hours: 1 credit

Course Description:

Physics focuses on mastery of the PA Academic Standards for Science and Technology and is the equivalent of a first-semester college course in algebra-based physics. As students progress through physics, they will participate in a systematic study of Newtonian mechanics (including rotational dynamics and angular momentum); work, energy, and power; and mechanical waves and sound. It will also introduce electric circuits.

Physics is the branch of science that studies the physical world. In particular, physics explores the interactions of matter and energy. Physics is a math-intensive subject in which physical phenomena are explained by mathematical relationships. Wherever possible, demonstrations and lab exercises reinforce understanding and show the application of physics principles in everyday life. A broad objective for this course is to heighten awareness of the scientific happenings of the world and to promote critical thinking and problem solving skills.

Learning Activities / Modes of Assessment:

Large group instruction	Tests and Quizzes
Laboratory experiments	Checklists / Teacher Observation
Small group work	Projects with Rubrics
Computer simulations / Video Analysis	Lab Reports / Write-ups
Reading assignments	Writing / essays

Instructional Resources:

Physics (Holt, 2000), by Raymond Serway.
Logger Pro software
Interactive Physics software
Excel, Powerpoint, Word
Moodle
eInstruction software
Phet online physics simulations
Sustainable Energy – Without the Hot Air, ebook by David MacCay
Google Docs
Discovery Education video services
Central Columbia School District Educational Video Library
Understanding Car Crashes video from Insurance Institute for Highway Safety
Short video clips from movies for video analysis
Various instructional videos and educational websites

Course Pacing Guide

Course: **Physics**

Course Unit (Topic)	**Length of Instruction (Days/Periods)**
1. Kinematics	35 days
2. Force and Laws of Motion	20 days
3. Torque and Rotational Dynamics	15 days
4. Circular Motion, Simple Harmonic Motion, Universal Gravitation	15 days
5. Momentum	20 days
6. Energy	25 days
7. Mechanical Waves and Sound	20 days
8. Electric Circuits	25 days
DAYS TOTAL	175 Days

Course: Physics
Teacher: Thomas Gill

Topic: 01 – Kinematics Days: 35

Know

terms relating to motion including: vector, scalar, position, displacement, speed, velocity, acceleration, equations such as:vf=vi +at, vf^2=vi^2+2ax, x = vit + 1/2 at^2, x = 1/2(vi + vf)t, Position, Velocity, and Acceleration graphs; Equations of motion; use of sine and cosine to resolve a vector into horizontal and vertical components.

Understand

Motion can be analyzed through graphs using slopes and areas or using equations to determine quantities such as displacement, velocity, and acceleration.

Do

3.2.P.B1.a – FORCE & MOTION OF PARTICLES AND RIGID BODIES - Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration.
3.2.P.B1.b – FORCE & MOTION OF PARTICLES AND RIGID BODIES - Use force and mass to explain translational motion or simple harmonic motion of objects.
S8.A.2.1.1 – Use evidence, observations, or a variety of scales (e.g., time, mass, distance, volume, temperature) to describe relationships.
S8.A.2.1.2 – Use space/time relationships, define concepts operationally, raise testable questions, or formulate hypotheses.
S8.A.2.1.4 – Interpret data/observations; develop relationships among variables based on data/observations to design models as solutions.
S11.C.3.1.3 -- Explain that acceleration is the rate at which the velocity of an object is changing.
SI.11-12.1 – Examine the status of existing theories.
9-10.R.S.7 – Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
9-10.R.S.3 – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

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Topic: 02 – Force and the Laws of Motion Days: 20

Know

Terms relating to motion and forces including: vector, scalar, position, displacement, speed, velocity, acceleration, force, inertia, coefficient of friction, static friction, kinetic friction, equations such as: w = mg, F=ma, f=(mu)N; Newton's Laws.

Understand

The sum of all the forces acting on an object (which may include its weight, normal force, friction, and other forces) will determine whether it remains at rest, moves with constant velocity or accelerates.

Do

3.2.P.B1.a – FORCE & MOTION OF PARTICLES AND RIGID BODIES - Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration.
3.2.P.B1.b – FORCE & MOTION OF PARTICLES AND RIGID BODIES - Use force and mass to explain translational motion or simple harmonic motion of objects.
3.2.P.B6. – UNIFYING THEMES - PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
S8.A.2.1.1 – Use evidence, observations, or a variety of scales (e.g., time, mass, distance, volume, temperature) to describe relationships.
S8.A.2.1.2 – Use space/time relationships, define concepts operationally, raise testable questions, or formulate hypotheses.
S8.A.2.1.4 – Interpret data/observations; develop relationships among variables based on data/observations to design models as solutions.
S11.C.3.1.3 -- Explain that acceleration is the rate at which the velocity of an object is changing.
SI.11-12.1 – Examine the status of existing theories.
9-10.R.S.7 – Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
9-10.R.S.3 – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
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.

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Topic: 03 – Torque and Rotational Dynamics Days: 15

Know

terms relating to motion and forces including: torque, angular acceleration, equilibrium, and moment of inertia; equations such as torque = rxF, net torque = I alpha, Newton's Laws for Rotational Motion.

Understand

The sum of all the torques acting on an object will determine whether it is in rotational equilibrium or whether it has angular acceleration.

Do

3.2.P.B1.a – FORCE & MOTION OF PARTICLES AND RIGID BODIES - Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration.
3.2.P.B1.c – FORCE & MOTION OF PARTICLES AND RIGID BODIES - Relate torque and rotational inertia to explain rotational motion.
S8.A.2.1.1 – Use evidence, observations, or a variety of scales (e.g., time, mass, distance, volume, temperature) to describe relationships.
S8.A.2.1.2 – Use space/time relationships, define concepts operationally, raise testable questions, or formulate hypotheses.
S8.A.2.1.4 – Interpret data/observations; develop relationships among variables based on data/observations to design models as solutions.
S11.C.3.1.3 --
Explain that acceleration is the rate at which the velocity of an object is changing.
SI.11-12.1 – Examine the status of existing theories.
9-10.R.S.7 – Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
9-10.R.S.3 – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
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.

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Topic: 04 – Circular Motion, Simple Harmonic Motion, Universal Gravitation Days: 15

Know

Terms relating to circular motion, simple harmonic motion, and gravitation including: centripetal, frequency, period, amplitude, angular frequency, and universal gravitation constant. Equations including a = v^2/r, F=Gm1m2/r^2, x=Asin(wt), v=Awcos(wt), a=-Aw^2sin(wt).

Understand

Circular motion and simple harmonic motion share the property of having a force pulling toward the center of the motion. Universal gravitation is an example of a force that often causes circular motion.

Do

3.2.P.B1.a – FORCE & MOTION OF PARTICLES AND RIGID BODIES - Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration.
3.2.P.B1.b – FORCE & MOTION OF PARTICLES AND RIGID BODIES - Use force and mass to explain translational motion or simple harmonic motion of objects.
3.2.P.B6. – UNIFYING THEMES - PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
S8.A.2.1.1 – Use evidence, observations, or a variety of scales (e.g., time, mass, distance, volume, temperature) to describe relationships.
S8.A.2.1.2 – Use space/time relationships, define concepts operationally, raise testable questions, or formulate hypotheses.
S8.A.2.1.4 – Interpret data/observations; develop relationships among variables based on data/observations to design models as solutions.
S11.C.3.1.3 -- Explain that acceleration is the rate at which the velocity of an object is changing.
SI.11-12.1 – Examine the status of existing theories.
9-10.R.S.7 – Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
9-10.R.S.3 – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
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.
HS-PS2-4. – Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

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Topic: 05 – Momentum Days: 20

Know

Terms relating to momentum including impulse, elastic and inelastic collision, conservation of momentum, conservation of angular momentum, and kinetic energy; equations including p=mv, J=ft, mv=Ft, L=Iw. Concepts including impulse, conservation of momentum and angular momentum,.

Understand

Energy and momentum are conserved quantities and can be used to predict the behavior of complex systems.

Do

3.2.P.B2.a --ENERGY STORAGE AND TRANSFORMATIONS:CONSERVATION LAWS - Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum.
11-12.R.S.2 --Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
11-12.R.S.3 -- Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
11-12.R.S.8 --Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
3.2.12.B2.b --ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
SI.11-12.3 -- Judge that conclusions are consistent and logical with experimental conditions.
SI.11-12.4 -- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
3.4.10.C1. -- DESIGN ATTRIBUTES - Apply the components of the technological design process.
3.2.P.B2.b --
ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum.
9-10.R.S.7 -- Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. 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 refine a device that minimizes the force on a macroscopic object during a collision.

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Topic: 06 – Energy Days: 25

Know

Terms relating to energy including work, potential, kinetic, gravitational, elastic, and rotational energy. Equations including W=Fd, KE=1/2mv^2, GPE=mgh, P=W/t or E/t or Fv, K=1/2Iw^2. Concepts including conservation of energy.

Understand

Energy is a key part of our country's economic future what makes all physical processes occur. The conservation of energy is a foundation of physics.

Do

3.2.P.B2.a --ENERGY STORAGE AND TRANSFORMATIONS:CONSERVATION LAWS - Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum.
4.3.12.B.a -- Analyze factors that influence the local, regional, national, and global availability of natural resources.
4.3.12.B.b -- Compare the use of natural resources in different countries.
4.3.12.A.a -- Evaluate the advantages and disadvantages of using renewable and nonrenewable resources.
4.3.12.A.b -- Explain how consumption rate affects the sustainability of resource use.
4.3.12.A.c -- Evaluate the advantages and disadvantages of using renewable resources such as solar power, wind power, and biofuels.
11-12.R.S.2 --Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
11-12.R.S.3 -- Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
11-12.R.S.8 --
Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
3.2.12.B2.b --
ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.12.B2.a -- ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Explain how energy flowing through an open system can be lost.
3.2.12.B6. -- UNIFYING THEMES - CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.
SI.11-12.3 -- Judge that conclusions are consistent and logical with experimental conditions.
SI.11-12.4 -- Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution.
3.4.10.C1. -- DESIGN ATTRIBUTES - Apply the components of the technological design process.
3.2.P.B2.b --
ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum.
9-10.R.S.7 -- Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. 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.

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Topic: 07 – Mechanical Waves and Sound Days: 20

Know

Terms relating to waves including: simple harmonic motion, amplitude, period, frequency, wavelength, diffraction, interference, refraction, reflection, Doppler effect, resonance Equations including: v=f x wavelength, inverse square law, Doppler equation Concepts include: Waves, forms of electromagnetic radiation, properties of light, human vision, human hearing, diffraction and interference, reflection, refraction, sound

Understand

The properties of waves make them useful for a variety of purposes including energy transfer, communication, and measurement.

Do

3.2.C.B5.a – NATURE OF WAVES (SOUND AND LIGHT ENERGY) - Explain how waves transfer energy without transferring matter.
3.2.P.B5.b – NATURE OF WAVES (SOUND AND LIGHT ENERGY) - Explain how waves carry information from remote sources that can be detected and interpreted.
3.2.P.B5.c – NATURE OF WAVES (SOUND AND LIGHT ENERGY) - Describe the causes of wave frequency, speed, and wave length

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Topic: 08 – Electric Circuits Time: 25 days

Know

Terms relating to electrical circuits including: electric charge, resistance, conductivity, voltage, current, electomagnetic induction, potential difference, charge, conductor, insulator, semiconductor, kilowatthour. Equations including: I=V/R, P=IV, E=Pt. Concepts including: series and parallel circuits, conservation of charge, Kirchoff's rules, circuits, electricity in everyday life, Ohm's Law.

Understand

Electric circuits are the basis of many modern technologies and can be described in terms of voltage, current, and resistance.

Do

3.2.P.B4.a – ELECTRICAL AND MAGNETIC ENERGY - Explain how stationary and moving particles result in electricity and magnetism.
3.2.P.B4.b – ELECTRICAL AND MAGNETIC ENERGY - Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them.
3.2.C.B4.c – ELECTRICAL AND MAGNETIC ENERGY - Explain how electrical induction is applied in technology.
9-10.R.S.3 – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.