**Physics I Curriculum Guide**

**Introduction:**

In high school Introductory Physics (or physical science), students recognize the nature and scope of physics, including its relationship to the other sciences. Students learn about basic topics such as motion, forces, energy, heat, waves, electricity, and magnetism. They learn about natural phenomena by using physical laws to calculate quantities such as velocity, acceleration, momentum, and energy. Students of introductory physics (or physical science) learn about the relationships between motion and forces through Newton’s laws of motion. They study the difference between vector and scalar quantities and learn how to solve basic problems involving these quantities. Students learn about conservation of energy and momentum and how these are applied to everyday situations. They learn about heat and how thermal energy is transferred throughout the different phases of matter. Students extend their knowledge of waves and how they carry energy. Students gain a better understanding of electric current, voltage, and resistance by learning about Ohm’s law. They also gain knowledge about the electromagnetic spectrum in terms of wavelength and frequency.

**To be successful in this course, students are expected to know the content of the MA Mathematics Curriculum Framework, through grade 8.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Student Performance Objectives** | | **Resources / Activities** |  |
|  |  |  | **(Cornerstone Activities in Bold)** |  |
|  | **Skills from the Mathematics Framework.** | | CPO PFC S&P WKSHT 1.2: |  |
|  | The student will be able to: | | Dimensional Analysis |  |
|  | Construct and use tables and graphs to interpret data sets. | | CPO PFC S&P WKSHT 1.3: |  |
|  | Solve simple algebraic expressions. | |  |
| **Standards** | Perform basic statistical procedures to analyze the center and spread of data. | | Working with Quantities and Rates |  |
| Measure with accuracy and precision (e.g., length, volume, mass, temperature, time) | | CPO PFC S&P WKSHT 1.3: |  |
| Convert within a unit (e.g., centimeters to meters) | |  |
| Problem Solving with Rates |  |
| Use common prefixes such as milli-, centi-, and kilo-. | |  |
|  |  |
|  | Use scientific notation, where appropriate. |  |  |
| **Mathematical** | CPO PFC S&P WKSHT 1.2: |  |
| Use ratio and proportion to solve problems. | |  |
| International System of |  |
|  |  |  |
| **Skills not in the Mathematics Framework, but are necessary for a solid understanding in this course.** | | Measurements |  |
|  |  |
| The student will be able to: | | CPO PFC M WKSHT: Scientific |  |
| Determine the correct number of significant figures. | |  |
| Notation |  |
|  | Determine percent error from experimental and accepted values. |  |
|  |  |
|  | Use appropriate metric/standard international (SI) units of measurement for mass (kg); length (m); time (s); force (N); speed (m/s); acceleration (m/s2); frequency | | CPO PFC M WKSHT: Ratios & |  |
|  |  | (Hz); work and energy (J); power (W); momentum (kg\*m/s); electric current (A); electric potential difference/voltage (V); and electric resistance (Ω). |  |
|  |  | Proportions in a Recipe |  |
|  | Use the Celsius and Kelvin scales. | |  |  |
|  |  |  |  |  |

1

**Physics I Curriculum Guide**

Scientific literacy can be achieved as students inquire about the physical world. The physical science curriculum includes substantial hands-on laboratory experiences, as appropriate. Though the following skills will be weaved into the curriculum and practiced throughout the course, they will also be addressed at the beginning of the course as a stand-alone introductory unit.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Intro. Unit** | **Scientific Inquiry Skills** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 10 Classes)** | **Standards** |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  | SIS1. Make observations, raise | How do scientists know | The student will know that: | The student will be able to: | **Measuring Main Street Activity** |  |
|  | questions, and formulate | what questions to ask? | Science is based on facts, data, and | Observe the world from a scientific |  |  |
|  | hypotheses. |  | evidence. | perspective. | Psychic Physics Phish Activity |  |
|  |  |  | Scientists observe the natural world and | Pose questions and form hypotheses | Pendulum Lab |  |
|  |  |  | are curious about it. | based on personal observations, scientific |  |
| **Skills** |  |  | Scientists think critically about the | articles, experiments, and knowledge. |  |  |
|  |  | natural world. | Read, interpret, and examine the credibility |  |  |
|  |  |  | and validity of scientific claims in different |  |  |
| **Introductory Unit: Scientific Inquiry***ApproximateTimeline:September* |  |  |  | sources of information, such as scientific |  |  |
|  |  |  | articles, advertisements, or media stories. |  |  |
| SIS2. Design and conduct | How do scientists | The student will know that: | The student will be able to: | Walk/Jog/Run Activity |  |
| scientific investigations. | collect data? | Scientists are creative. | Articulate and explain the major concepts |  |  |
|  |  | Scientists must possess excellent | being investigated and the purpose of an |  |  |
|  |  | communication skills. | investigation. |  |  |
|  |  | Scientists relate complex ideas. | Select required materials, equipment, and |  |  |
|  |  | Scientists use appropriate materials and | conditions for conducting an experiment. |  |  |
|  |  | follow safety guidelines when conducting | Identify independent and dependent |  |  |
|  |  | an investigation. | variables. |  |  |
|  |  |  | Write procedures that are clear and |  |  |
|  |  |  | replicable. |  |  |
|  |  |  | Employ appropriate methods for accurately |  |  |
|  |  |  | and consistently making observations, |  |  |
|  |  |  | making and recording measurements at |  |  |
|  |  |  | appropriate levels of precision, and |  |  |
|  |  |  | collecting data or evidence in an organized |  |  |
|  |  |  |  |  |  |
|  |  |  |  | way. |  |  |
|  |  |  |  | Properly use instruments, equipment, and |  |  |
|  |  |  |  | materials including set-up, calibration, |  |  |
|  |  |  |  | technique, maintenance, and storage. |  |  |
|  |  |  |  | Follow safety guidelines. |  |  |

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**Physics I Curriculum Guide**

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| **Intro. Unit** | **Scientific Inquiry Skills** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 10 Classes)** | **Standards** |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  | SIS3. Analyze and interpret | How do scientists find | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 7.1: Indirect |  |
|  | results of scientific | patterns in nature? | Scientists must present their findings in a | Present relationships between and among | Measurement |  |
|  | investigations. |  | clear manner. | variables in appropriate forms. (Represent |  |  |
|  |  |  | Scientists may use mathematical | data and relationships between and among |  |  |
|  |  |  | relationships to find a pattern. | variables in charts and graphs. Use |  |  |
|  |  |  | Scientists may use graphs to find a pattern. | appropriate technology and other tools.) |  |  |
|  |  |  | Scientists analyze the reliability of their | Use mathematical operations to analyze and |  |  |
| **Skills** |  |  | data. | interpret data results. |  |  |
|  |  | Scientists know that all data has error in it. | Assess the reliability of data and identify |  |  |
|  |  | Scientists form conclusions that either | reasons for inconsistent results, such as |  |  |
|  |  | support or refute their hypothesis. | source of error or uncontrolled conditions. |  |  |
| **Introductory Unit: Scientific Inquiry***ApproximateTimeline:September* |  |  |  |  |
|  |  | Scientists think further about their | Use results of an experiment to develop a |  |  |
|  |  | investigation and plan for continued study. | conclusion to an investigation that addresses |  |  |
|  |  |  | the initial questions and supports or refutes |  |  |
|  |  |  | the stated hypothesis. |  |  |
|  |  |  | State questions raised by an experiment that |  |  |
|  |  |  | may require further investigation. |  |  |
| SIS4. Communicate and apply | How do scientists share | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 1.2: Making |  |
| the results of scientific | their understanding of | Scientists use an array of tools such as | Develop descriptions of and explanations for | Line Graphs |  |
| investigations. | nature? | graphs, tables, and charts to explain their | scientific concepts that were a focus of one |  |  |
|  |  | findings. | or more investigations. |  |  |
|  |  | Scientists use correct language (punctuation | Review information, explain statistical |  |  |
|  |  | and spelling) to communicate their findings. | analysis, and summarize data collected and |  |  |
|  |  | Create models to simulate their findings. | analyzed as the result of an investigation. |  |  |
|  |  |  | Explain diagrams and charts the represent |  |  |
|  |  |  | relationships or variables. |  |  |
|  |  |  | Construct a reasoned argument and respond |  |  |
|  |  |  |  | appropriately to critical comments and |  |  |
|  |  |  |  | questions. |  |  |
|  |  |  |  | Use language and vocabulary appropriately, |  |  |
|  |  |  |  | speak clearly and logically, and use |  |  |
|  |  |  |  | appropriate technology and other tools to |  |  |
|  |  |  |  | present findings. |  |  |
|  |  |  |  | Use and refine scientific models that |  |  |
|  |  |  |  | simulate physical processes or phenomena. |  |  |

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**Physics I Curriculum Guide**

**Learning Standards for a Full First-Year Course in High School Introductory Physics (or physical science.)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Unit 1** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 49 Classes)** | | |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  |  |  | 1.1 Compare and contrast | How can vectors be | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 6.1: Adding |  |
|  |  |  | vector quantities (e.g., | used to solve real-world | Scalars only have magnitude. | Define and identify vector and scalar | Displacement Vectors |  |
|  |  |  | displacement, velocity, | problems | Vectors have magnitude and direction. | quantities. |  |  |
|  |  |  | acceleration force, linear |  | Vectors can be added or subtracted from | Provide examples of vector and scalar | CPO PFC M WKSHT: 2-D Vectors |  |
|  | ***Central Concept*:**Newton’s Laws of motion and gravitation |  | momentum) and scalar |  | component vectors to form a resultant | quantities. |  |  |
|  |  | quantities (e.g., distance, |  | vector. | Apply an understanding of vectors to | CPO PFC M WKSHT: Pythagorean |  |
|  | describe and predict the motion of most objects. | speed, energy, mass, work). |  | Arrows are used to represent vectors. | velocity, acceleration, force, and | Theorem |  |
| **Unit 1: Motion and Forces***ApproximateTimeline:LateSeptember-December* |  |  |  | momentum. |  |  |
|  |  |  | Graphically represent vector quantities. |  |  |
|  |  |  | Add and subtract collinear vector |  |  |
|  |  |  | quantities. |  |  |
|  |  |  | Add vectors at right angles. |  |  |
| 1.2 Distinguish between | How can words be used | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 1.3: Speed |  |
| displacement, distance, | to describe an object’s | Distance is a scalar that is measured in | Define and calculate the distance and | Problems |  |
| velocity, speed, and | motion? | meters and tells you how far an object | displacement of an object. |  |  |
| acceleration. Solve problems |  | travels. | Define and calculate the average speed | CPO PFC S&P WKSHT 2.2: |  |
| involving displacement, |  | Displacement is a vector that is measured in | and average velocity of an object. | Acceleration Problems |  |
| distance, velocity, speed, and |  | meters and is found by subtracting the end | Distinguish among average speed, |  |  |
| constant acceleration. |  | point from the start point and tells you | average velocity, and acceleration. | CPO PFC S&P WKSHT 2.2: |  |
|  |  | where the object stopped compared to | Distinguish between average speed and | Acceleration Due to Gravity |  |
|  |  | where it started. | instantaneous speed. | CPO PFC S&P WKSHT 6.1: Projectile |  |
|  |  | Average speed is a scalar that is measured | Solve mathematical problems involving |  |
|  |  | in m/sec and is found by dividing the total | distance, displacement, speed, velocity, | Motion |  |
|  |  | distance. | and acceleration. | Constant Motion Buggy Activity |  |
|  |  | Average velocity is a vector that is |  |  |
|  |  | measured in m/sec and is found by dividing |  |  |  |
|  |  | the displacement by the total time. |  | Accelerated Motion Labs |  |
|  |  | Acceleration is a vector that is measured in |  | Marble and Ramp Activity |  |
|  |  | m/sec2 and is found by dividing the change |  |  |
|  |  |  | Ticker-tape Time Activity |  |
|  |  | in velocity by the change in time. |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  | Instantaneous speed is the speed at a |  | Combined Motion Lab |  |
|  |  |  |  |  | particular moment in time. |  |  |
|  |  |  |  |  | Average speed is a weighted average of all |  | Projectile Motion Activity |  |
|  |  |  |  |  | the instantaneous speeds during a trip. |  |  |  |

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**Physics I Curriculum Guide**

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**Physics I Curriculum Guide**

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|  | **Unit 1** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 49 Classes)** | | |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  |  |  | 1.3 Create and interpret graphs | How can a graph be | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 2.4: Analyzing |  |
|  |  |  | of 1-dimensional motion, such | used to describe an | A position v. time graph can be used to | Create graphs of motion (position v. time, | Graphs of Motion Without Numbers |  |
|  |  |  | as position vs. time, distance | object’s motion? | represent the change in position of an | speed v. time, velocity v. time, and |  |  |
|  |  |  | vs. time, speed vs. time, |  | object. | constant acceleration v. time.) | CPO PFC S&P WKSHT 2.4: Analyzing |  |
|  |  |  | velocity vs. time, and |  | The slope on a position v. time graph tells | Interpret graphs of motion (position v. | Graphs of Motion With Numbers |  |
|  |  |  | acceleration vs. time where |  | you the average speed of the object. | time, speed v. time, velocity v. time, and |  |  |
|  |  |  | acceleration is constant. |  | A velocity v. time graph can be used to | constant acceleration v. time.) | CPO PFC M WKSHT: Slope |  |
|  |  |  |  |  | represent the change in velocity of an | Read a “dot diagram” or “oil drop | CPO PFC M WKSHT: Slope from a |  |
|  | ***Central Concept*:**Newton’s Laws of motion and gravitation |  |  |  | object. | diagram” to identify an object’s motion. |  |
|  |  |  |  | The slope on a velocity v. time graph tells | Interpret a “dot diagram” or “oil dot | Graph |  |
| **Unit 1 (Cont’d): Motion and Forces***ApproximateTimeline:LateSeptember-December* | describe and predict the motion of most objects. |  |  | you the average acceleration of the object. | diagram” to identify an object’s motion. | Walk/Jog/Run Activity |  |
|  |  |  |  |  |
|  |  |  |  | **Motion Detector Lab (PvT)** |  |
|  |  |  |  | **Motion Detector Lab (VvT)** |  |
|  |  |  |  | The Big Graph |  |
|  |  |  |  | Rubber Band Car Project |  |
| 1.4 Interpret and apply | What causes an object | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 2.1: Mass vs. |  |
| Newton’s three laws of | to change its state of | Mass does not change no matter an object’s | Distinguish between mass and weight. | Weight |  |
| motion. | motion? | location. | Explain the relationship between mass | CPO PFC S&P WKSHT 2.2: Newton’s |  |
|  |  | Weight depends on both the mass and | and inertia. |  |
|  |  | location of an object. | Solve problems that relate mass to | Second Law |  |
|  |  | Inertia is related to mass. | weight. | Inertia Smorgasboard Activity |  |
|  |  | The acceleration of an object depends on its | Explain inertia’s role in the motion of |  |
|  |  | mass and the net force acting on it. | objects. | Cart and Ramp Activity |  |
|  |  | Every action force has an equal and | Solve problems relating acceleration, |  |
|  |  | opposite reaction force. | mass, and net force. | Balloon Rocket Project |  |
|  |  | Mass is measured in kilograms. | Identify action / reaction pairs. |  |
|  |  |  |  |
|  |  |  |  |  |  |
| 1.5 Use a free-body force | How are pictures used | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 5.2: |  |
| diagram to show forces acting | to show the forces | The following forces may be acting on an | Distinguish between contact and non- | Equilibrium |  |
|  |  |  |  |
|  |  |  | on a system consisting of a | acting on an object? | object (i.e., weight, normal, tension, | contact forces. |  |  |
|  |  |  | pair of interacting objects. For |  | applied, friction, air resistance.) | Identify and describe the forces acting on |  |  |
|  |  |  | a diagram with only co-linear |  | Every force has a description that includes | an object. |  |  |
|  |  |  | forces, determine the net force |  | the direction the force acts and the situation | Draw a free-body diagram of the forces |  |  |
|  |  |  | acting on a system and |  | in which it is present. | acting on an object. |  |  |
|  |  |  | between the objects. |  | Force is measured in Newtons (a.k.a., | Interpret free-body diagrams. |  |  |
|  |  |  |  |  | Kgm/sec2) | Find the net force from a free-body |  |  |
|  |  |  |  |  |  | diagram. |  |  |

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|  | **Unit 1** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 49 Classes)** | | |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  |  |  | 1.6 Distinguish qualitatively | How does friction | The student will know that: | The student will be able to: | Demo: VDL and Force Sensor |  |
|  |  |  | between static and kinetic | affect the motion of | There are two forms of friction (i.e., static | Define static and kinetic friction. |  |  |
|  |  |  | friction, and describe their | objects? | friction and kinetic friction.) | Identify if static or kinetic friction is |  |  |
|  | ***Central Concept***: Newton’s Laws of motion and gravitation |  | effects on the motion of |  | Static friction holds objects in place. | present. |  |  |
|  |  | objects. |  | Kinetic friction slows objects down. | Explain how static and kinetic friction |  |  |
|  |  |  |  | The magnitude of the static friction force is | impacts the motion of an object. |  |  |
| **Unit 1 (Cont’d): Motion and Forces***ApproximateTimeline:LateSeptember-December* | describe and predict the motion of most objects. |  |  | greater than the magnitude of the kinetic |  |  |  |
|  |  | friction force. |  |  |  |
|  |  |  |  |  |  |
| 1.7 Describe Newton’s law of | What factors affect the | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 6.3: |  |
| universal gravitation in terms | force of gravity acting | All objects exert a gravitation force on one | Predict if and by how much the force of | Universal Gravitation |  |
| of the attraction between two | on an object? | another. | gravity changes based on the separation |  |  |
| objects, their masses, and the |  | The mass of each object is directly related | distance between the objects. | CPO PFC S&P WKSHT: 18.1: |  |
| distance between them. |  | to the force of gravity. | Predict if and by how much the force of | Inverse Square Law |  |
|  |  | The separation distance between object’s | gravity changes based on the mass of the |  |  |
|  |  | has an inverse-square relationship with the | objects. |  |  |
|  |  | force of gravity. | Explain in words how the force of gravity is |  |  |
|  |  |  | related to the mass and separation distances |  |  |
|  |  |  | of the objects. |  |  |
|  |  |  |  |  |  |
| 1.8 Describe conceptually the | What causes an object | The student will know that: | The student will be able to: | Demo: Constant Motion Buggy |  |
| forces involved in circular | to move in a circle? | Objects moving in a circle are accelerating | Define centripetal force. |  |  |
| motion. |  | because their direction is constantly | Identify if a centripetal force is present in a |  |  |
|  |  | changing. | situation. |  |  |
|  |  | The net force acting on an object moving in | Identify the type of centripetal force present. |  |  |
|  |  | a circle is called the centripetal force. | Explain what would happen to the motion of |  |  |
|  |  | The centripetal force is always directed | an object if the centripetal force disappears. |  |  |
|  |  | inward to the center of the circle of motion. |  |  |  |
|  |  |  |  |  | The centripetal force is a general force and |  |  |  |
|  |  |  |  |  | can be due a friction, tension, gravity, or |  |  |  |
|  |  |  |  |  | applied force. |  |  |  |
|  |  |  |  |  |  |  |  |  |

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**Physics I Curriculum Guide**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Unit 2** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 17 Classes)** | | |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  |  |  | 2.1 Interpret and provide | How is energy | The student will know that: | The student will be able to: | WKSHT: Energy Transformations in |  |
|  | ***Central Concept*:**The laws of conservation of energy and momentum provide |  | examples that illustrate the law | conserved in the | Energy is a scalar quantity. | Define the following terms: energy, | common devices |  |
|  |  | of conservation of energy. | universe? | Energy comes in many forms and is only | potential energy, kinetic energy, |  |  |
|  | alternate approaches to predict and describe the movement of objects. |  |  | apparent when it changes forms. | gravitational potential energy, and elastic |  |  |
|  |  |  | Heat is a form of energy and results from | potential energy. |  |  |
|  |  |  | friction. | Identify the types of energy present in a |  |  |
|  |  |  | Energy is often lost to heat. | situation. |  |  |
| **Unit 2: Conservation of Energy and Momentum***ApproximateTimeline:January* |  |  | Energy can never be created nor destroyed; | Describe the following types of energy: |  |  |
|  |  | it can only change forms. | mechanical, heat, chemical, nuclear, and |  |  |
|  |  | Energy is measured in joules (a.k.a., Nm) | electromagnetic. |  |  |
|  |  |  | Draw energy path transfer diagrams. |  |  |
|  |  |  |  |  |  |
| 2.2 Interpret and provide | How is energy | The student will know that: | The student will be able to: | Demo: Pendulum |  |
| examples of how energy can be | conserved when a ball | The motion of an object can be described in | Calculate gravitational potential energy. |  |  |
| converted from gravitational | is dropped? | terms of its energy. | Calculate kinetic energy. | CPO PFC S&P WKSHT 3.2: Potential |  |
| potential energy to kinetic |  | Gravitational potential energy is directly | Calculate the total energy. | and Kinetic Energy |  |
| energy and vice versa. |  | proportional to an object’s position. | Use the law of conservation of energy to | Simulation: PhET – Energy Skate |  |
|  |  | Kinetic energy is directly proportional to | determine the PE, KE, and TE of an object |  |
|  |  | the square the speed of an object. | in motion. | Park |  |
|  |  | Gravitational potential energy decreases |  |  |  |
|  |  | when an object falls. |  |  |  |
|  |  | Kinetic energy increases when an object |  |  |  |
|  |  | falls. |  |  |  |
|  |  | The total energy at any point is equal to the |  |  |  |
|  |  | sum of the KE and PE. |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |

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|  | **Unit 2** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | | **Resources / Activities** |  |
| **(~ 17 Classes)** | | |  |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  |  |  | 2.3 Describe both qualitatively | What happens to | The student will know that: | The student will be able to: | | CPO PFC S&P WKSHT 3.2: Work |  |
|  | of |  | and quantitatively how work | energy when work is | Work is done when an object moves in the | Define work. | | CPO PFC S&P WKSHT 4.1: Work |  |
|  | ***Central Concept*:**The laws of conservation of energy andmomentumprovidealternateapproachestopredictanddescribethemovement |  | can be expressed as a change in | done? | direction it is pushed or pulled. | Determine if work is done on an object in | |  |
|  |  | mechanical energy. |  | The amount of work that is done on an | different situations. | | Done Against Gravity |  |
|  |  |  |  | object is proportional to the force applied | Calculate the amount of work done on an | |  |  |
| **Unit 2 (Cont’d): Conservation of Energy and Momentum***ApproximateTimeline:January* |  |  |  | and the distance it moves. | object. | |  |  |
|  |  |  | Work equals force times distance. | Determine the change of energy of an | |  |  |
|  |  |  | When work is done on an object, its energy | object. | |  |  |
|  |  |  | changes. |  |  |  |  |
|  |  |  | When an object’s energy changes, work has |  |  |  |  |
|  |  |  | been done on it. |  |  |  |  |
|  |  |  | Work is measured in Joules (a.k.a., Nm) |  |  |  |  |
| objects. |  |  |  |  | |  |  |
| 2.4 Describe both qualitatively | How much power is | The student will know that: | The student will be able to: | | CPO PFC S&P WKSHT 4.1: Power |  |
| and quantitatively the concept | required to climb a set | The power rating of a machine is directly | Define power. | |  |  |
| of power as work done per unit | of stairs? | proportional to the amount of work it does. | Calculate the power rating of mechanical | | CPO PFC S&P WKSHT 10.2: Power |  |
| time. |  | The power rating of a machine is inversely | objects. | | in Flowing Energy |  |
|  |  | proportional to the amount of time it takes | Convert between watts and horsepower. | | **Human Work and Power Activity** |  |
|  |  | to do the work. |  |  |  |
|  |  | A machine that does the same amount of |  |  |  |  |
|  |  | work in less time is more powerful. |  |  |  |  |
|  |  | Power is measured in Watts (a.k.a., |  |  |  |  |
|  |  | Joules/sec) |  |  |  |  |
|  |  | 1 Watt equals 746 horsepower (hp) |  |  |  |  |
|  |  |  |  |  |  |  |
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|  | **Unit 2** |  |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 17 Classes)** | | |  |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  |  |  |  | 2.5 Provide and interpret | How is momentum | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 3.1: |  |
|  |  | of |  | examples showing that linear | conserved in | The momentum of an object is directly | Calculate an object’s momentum. | Momentum |  |
|  |  |  | momentum is the product of | collisions? | proportional to its mass and velocity. | Identify a collision as being elastic or |  |  |
|  |  | alternate approaches to predict and describe the movement |  | mass and velocity, and is |  | Momentum equals mass times velocity. | inelastic. | CPO PFC S&P WKSHT 3.1: Impulse |  |
|  |  |  | always conserved (law of |  | Momentum is a vector quantity. | Predict the velocity of an object after it |  |  |
|  |  |  | conservation of momentum). |  | The total amount of momentum is a system | experiences an elastic collision. | CPO PFC S&P WKSHT 3.1: |  |
|  | ***Concept*:**The laws of conservation of energy and |  | Calculate the momentum of an |  | is equal before a collision and after a | Predict the velocity of an object after it | Momentum Conservation |  |
|  |  | object. |  | collision. | experiences an inelastic collision. | CPO PFC S&P WKSHT 3.2: |  |
|  |  |  |  | There are two types of collisions: elastic | Explain how an object that explodes has no |  |
| **Conservation of Energy and Momentum***ApproximateTimeline:January* |  |  |  | Collisions and Conservation of |  |
|  |  |  | and inelastic. | net momentum after the explosion. |  |
|  |  |  | Momentum |  |
|  |  |  | Elastic collisions occur when objects collide | Explain how car airbags work. |  |
|  |  |  |  |  |
|  |  |  | and bounce off each other. | Calculate the impulse an object experiences. | **Qualitative Collision Activity with** |  |
|  |  |  | Inelastic collisions occur when objects | Explain the relationship between impulse |  |
|  |  |  | **Pasco Tracks and Carts** |  |
|  |  |  | collide and stick to each other. | and momentum. |  |
|  |  |  |  |  |
|  |  |  | The forces acting on objects involved in a | Explain how to create a “safe” collision. | Quantitative Collision Activity |  |
|  |  |  | collision follow Newton’s 3rd Law of | Explain how a lacrosse stick works. |  |
| objects. |  |  | Motion; they are action/reaction pairs. | Explain how a karate chop works. | **The Egg Drop Project** |  |
|  |  | The unit for momentum is kg  m/sec. |  |  |
|  |  |  |  |  |
|  |  | Impulse equals force times time. |  |  |  |
|  |  | Changes in momentum are due to impulses. |  |  |  |
|  |  | Impulses cause changes in momentum. |  |  |  |
|  |  | The unit for impulse is kg  m/sec. |  |  |  |
|  |  |  |  |  |  |
| **2.** | ***Central*** | provide |  |  |  |  |  |  |  |
|  |  | momentum |  |  |  |  |  |  |  |
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|  | **Unit 3** |  |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 13 Classes)** | | |  |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  |  |  |  | 3.1 Explain how heat energy is | How does a thermos | The student will know that: | The student will be able to: | Demos: Metal Star, Convection Tube, |  |
|  |  | at |  | transferred by convection, | keep liquids hot (and | There are three methods of heat transfer. | Define the three methods of heat transfer. | Lamps |  |
|  | the processes of | regions that are |  | conduction, and radiation. | cold)? | Conduction is heat transfer by touch. | Explain how each heat transfer mechanism |  |  |
|  |  |  |  | Convection is heat transfer by currents. | can be slowed down. |  |  |
|  |  |  |  | Radiation is heat transfer by infrared light. | Identify the primary method of heat transfer |  |  |
|  |  |  |  |  | in a situation. |  |  |
|  |  |  |  |  | Explain how a thermos works. |  |  |
|  |  |  |  |  |  |  |  |
| **3. Heat and Heat Transfer***ApproximateTimeline:February* | ***Central Concept*:**Heat is energy that is transferred by | convection, conduction, and radiation between objects or | different temperatures. |  |  |  |  |  |  |
| 3.2 Explain how heat energy | How does insulation | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 7.2: |  |
| will move from a higher | work? | Objects that are at different temperatures | Predict the equilibrium temperature of | Temperature Scales |  |
| temperature to a lower |  | are in contact will reach thermal | objects that are in contact with one another. |  |  |
| temperature until equilibrium |  | equilibrium. | Determine the direction that heat is flowing. | CPO PFC M WKSHT: Functions – |  |
| is reached. |  | Heat always flows from hot objects to cold |  | Conversions Between Celsius & |  |
|  |  | objects. |  | Fahrenheit |  |
|  |  | An object feels cold to the touch because |  | **Thermal Equilibrium Lab** |  |
|  |  | your body is losing heat energy when it |  |  |
|  |  | touches it. |  |  |  |
|  |  | Insulation slows the transfer of heat from |  |  |  |
|  |  | one object to another. |  |  |  |
|  |  |  |  |  |  |
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|  | **Unit 3** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 13 Classes)** | | |  |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  |  | temperatures. | 3.3 Describe the relationship | Why does your hand | The student will know that: | | The student will be able to: | **Boiling Ice Lab** |  |
|  | convection, | between average molecular | feel cold when you hold |  | Thermal energy is proportional to the | Describe the relationship between average |  |  |
|  | kinetic energy and | and ice cube? |  | average kinetic energy in a substance. | kinetic energy and thermal energy. | Make Ice Cream |  |
|  | temperature. Recognize that |  |  | The faster the molecules of a substance are | Determine if an object’s molecules are |  |  |
|  | energy is absorbed when a |  |  | moving, the hotter it is. | moving relatively fast or slow. |  |  |
|  | substance changes from a |  |  | Heat is thermal energy in transit. | Define heat and thermal energy. |  |  |
|  | solid to a liquid to a gas, and |  |  | There are four phases of matter (i.e., solid, | Identify the four phases of matter and rank |  |  |
|  | is energy that is transferred by the processes of | between objects or regions that are at different |  |  |  |
|  | that energy is released when a |  |  | liquid, gas, plasma.) | them based on the average kinetic energy. |  |  |
|  | substance changes from a gas |  |  | The four phases of matter can be described | Distinguish between sensible and latent |  |  |
|  | to a liquid to a solid. Explain |  |  |  |
|  |  |  | by their thermal energy. | heating. |  |  |
|  | the relationships among |  |  |  |  |
|  |  |  | Heating an object can cause its temperature | Identify and define the four types of phase |  |  |
|  | evaporation, condensation, |  |  |  |
|  |  |  | to rise. | changes. |  |  |
| **3. Heat and Heat Transfer***ApproximateTimeline:February* | cooling, and warming. |  |  |  |  |
|  |  | There are four common types of phase | Differentiate between boiling and |  |  |
|  |  |  |  |
|  |  |  | changes. | evaporating. |  |  |
|  |  | The four common types of phase changes | | Explain the reason why an object’s |  |  |
|  |  |  | are melting, freezing, condensing, and | temperature does not change when heat is |  |  |
|  |  |  | evaporating. | added to it. |  |  |
|  |  | Boiling happens at the bottom of a liquid; | | Explain the reason why an object’s |  |  |
|  |  |  | evaporation happens at the surface. | temperature does not change when heat is |  |  |
|  |  | Heating an object can cause a phase change. | | removed from it. |  |  |
|  |  | When heat is added to an object and it | | Identify the phase changes that release heat |  |  |
|  |  |  | changes phase, its temperature does not | energy. |  |  |
|  |  |  | change. | b Identify the phase changes that absorb heat |  |  |
|  |  | Heat is released when objects change phase | | energy. |  |  |
|  |  |  | from gas to liquid, or liquid to solid. | Explain why citrus growers spray their |  |  |
|  |  |  Heat is absorbed when objects change phase | | crops with a light mist before a freeze. |  |  |
|  | ***Central Concept*:**Heat | conduction, and radiation |  |  |  |  |
|  |  |  |  | from solid to liquid, or liquid to gas. |  |  |  |
|  |  |  |  |  |  |  |  |
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|  | **Unit 3** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 13 Classes)** | | |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  | convection, | temperatures. | 3.4 Explain the relationships | When you are at a | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 7.3: Specific |  |
|  | among temperature changes in | beach in the summer, | The heat of an object is equal to its mass | Calculate the amount of heat needed to raise | Heat |  |
|  | a substance, the amount of | why does the sand feel | times its change in temperature times it | the temperature of an object. | **Mystery Metal Lab** |  |
|  | heat transferred, the amount | so hot while the ocean | specific heat capacity. | Compare the thermal inertia of various |  |
|  | (mass) of the substance, and | water feels so cool? | The specific heat capacity of an object is a | objects. |  |  |
|  | the specific heat of the |  | measure of how much heat energy is needed | Identify an object by its specific heat |  |  |
|  | is energy that is transferred by the processes of | between objects or regions that are at different | substance. |  | to raise the temperature of a 1gram object | capacity. |  |  |
|  |  |  | by 1C. |  |  |  |
|  |  |  | The specific heat capacity of water is 1.0 |  |  |  |
|  |  |  | cal/gC. |  |  |  |
|  |  |  | Objects with relatively high specific heat |  |  |  |
| **3. Heat and Heat Transfer***ApproximateTimeline:February* |  |  | capacities require a lot of heat energy to |  |  |  |
|  |  | change their temperatures. |  |  |  |
|  |  | Objects with relatively low specific heat |  |  |  |
|  |  | capacities require little heat energy to |  |  |  |
|  |  | change their temperatures. |  |  |  |
|  |  | Water has a high specific heat capacity |  |  |  |
|  |  | compared to sand. |  |  |  |
|  |  | Specific heat capacity is a physical property |  |  |  |
|  |  | of a material. |  |  |  |
|  |  | Heat is measured in calories (cal) or joules |  |  |  |
|  |  | (j). |  |  |  |
|  |  | 1,000 cal (science) = 1 Calorie (food) |  |  |  |
|  |  | 1 cal = 4.184 joules |  |  |  |
|  |  |  |  |  |  |
|  | ***Central Concept*:**Heat | conduction, and radiation |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |

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|  | **Unit 4** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 13 Classes)** | | |  |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  |  |  | 4.1 Describe the measurable | How can we use our | The student will know that: | | The student will be able to: | CPO PFC S&P WKSHT 20.1: Waves |  |
|  | of |  | properties of waves (velocity, | observations of ocean |  | Any motion that has a repetitive | Identify examples of simple harmonic |  |  |
|  |  | frequency, wavelength, | waves to understand |  | characteristic is called simple harmonic | motion. | CPO PFC S&P WKSHT 19.1: Period |  |
|  | transfer |  |  |  |
|  |  | amplitude, period) and explain | sound and light waves? |  | motion (i.e., pendulums, springs, and | Provide examples of simple harmonic | and Frequency |  |
|  |  | the relationships among them. |  |  | waves.) | motion. |  |  |
|  |  | Recognize examples of simple |  |  | Waves are caused by a disturbance. | Define a wave. |  |  |
|  | the |  | harmonic motion. |  |  | Waves are defined as a wiggle in space and | Identify the cause of a wave. |  |  |
|  |  |  |  |  | time. | Identify the measurable properties of a |  |  |
|  | without |  |  |  |  |  |  |
|  |  |  |  | Waves transfer energy and carry | | wave. |  |  |
|  |  |  |  |  | information from source to receiver. | Measure the properties of a wave. |  |  |
|  |  |  |  |  | All waves have measurable properties. | Use the wavespeed formula to calculate |  |  |
|  | carry energy from place to place |  |  |  |  |  |
|  |  |  |  | A wave crest is the highest point on a wave. | | wavespeed, wavelength, and frequency. |  |  |
| **4. Waves***ApproximateTimeline: March* |  |  |  | A wave trough is the lowest point on a wave | | Determine the frequency of wave by |  |  |
|  |  |  |  | and is measured in meters. | knowing its period. |  |  |
|  |  |  | The amplitude of a wave is the one-half the | | Determine the period of a wave by knowing |  |  |
|  |  |  |  | distance from a crest to a trough and is | its frequency. |  |  |
| matter. |  |  |  | measured in meters. |  |  |  |
|  |  | The wavelength of a wave is the distance | |  |  |  |
|  |  |  | from one place on a wave to the same place |  |  |  |
|  |  |  | on another wave (e.g., crest-to-crest) and is |  |  |  |
|  |  |  | measured in meters. |  |  |  |
|  |  | The velocity (wavespeed) of a wave is the | |  |  |  |
|  |  |  | found by measuring the amount of time it |  |  |  |
|  |  |  | takes for one wavelength to pass and is |  |  |  |
|  | Waves |  |  |  |  | measured in m/sec. |  |  |  |
|  |  |  |  | The period of a wave is the amount of time | |  |  |  |
|  |  |  |  |  | for one wave to occur and is measured in |  |  |  |
|  | ***Concept***: |  |  |  |  | seconds. |  |  |  |
|  |  |  |  | The frequency of a wave is defined as the | |  |  |  |
|  |  |  |  |  | number of waves that occurs in 1-sec and is |  |  |  |
|  |  |  |  |  | measured in Hertz (Hz). |  |  |  |
|  | ***Central*** |  |  |  | Wavespeed equals wavelength times | |  |  |  |
|  |  |  |  |  | frequency. |  |  |  |
|  |  |  |  |  | Period equals 1/frequency. |  |  |  |
|  |  |  |  |  | Frequency equals 1/period |  |  |  |
|  |  |  |  |  |  |  |  |
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|  | **Unit 4** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 13 Classes)** | | |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  | of |  | 4.2 Distinguish between | Why do you see | The student will know that: | The student will be able to: | Video: Fireworks |  |
|  |  | mechanical and | lightning before you | Mechanical waves are caused by vibrations | Differentiate between mechanical and |  |  |
|  | transfer |  | electromagnetic waves. | hear thunder? | of matter. | electromagnetic waves. |  |  |
|  |  |  |  | A medium is any type of matter (i.e., solid, | Define a medium and a vacuum. |  |  |
|  |  |  |  | liquid, gas.) | Describe the causes of mechanical and |  |  |
|  |  |  |  | Electromagnetic waves are caused by | electromagnetic waves. |  |  |
|  | the |  |  |  |  |  |
|  |  |  |  | vibrations of electrical and magnetic fields. | Identify waves as mechanical or |  |  |
|  | without |  |  |  |  |  |
|  |  |  |  | Mechanical waves need a medium to travel | electromagnetic. |  |  |
|  |  |  |  | through. |  |  |  |
|  |  |  |  | Electromagnetic waves do not need a |  |  |  |
|  | carry energy from place to place |  |  |  | medium to travel through (i.e., they can |  |  |  |
| **4. Waves***ApproximateTimeline: March* |  |  |  | travel through a vacuum.) |  |  |  |
|  |  |  | All electromagnetic waves travel a 3.00 x |  |  |  |
|  |  |  | 108 m/sec in a vacuum. |  |  |  |
|  | 4.3 Distinguish between the | What are the different | The student will know that: | The student will be able to: | **Slinky Lab** |  |
| matter. | two types of mechanical | ways that matter can | There are two types of mechanical waves: | Identify mechanical waves as transverse or |  |  |
| waves, transverse and | vibrate? | transverse waves and longitudinal waves. | mechanical waves. |  |  |
| longitudinal. |  | Longitudinal waves are created by a back- | Draw a longitudinal wave and label the |  |  |
|  |  | and-forth applied force. | compressions and rarefactions. |  |  |
|  |  | The energy in a longitudinal wave moves | Draw a transverse wave and label the crests |  |  |
|  |  | parallel to the direction of the applied force. | and troughs. |  |  |
|  |  | The energy in a transverse waves moves | Label and measure the wavelength on a |  |  |
|  |  | perpendicular to the direction of the applied | longitudinal wave. |  |  |
|  |  | force. | Label and measure the wavelength on a |  |  |
|  | Waves |  |  |  |  |  |
|  |  |  |  | Longitudinal waves are made up of | transverse wave. |  |  |
|  |  |  |  | compressions and rarefactions. |  |  |  |
|  |  |  |  | Transverse waves are made up crests and |  |  |  |
|  | ***Concept*:** |  |  |  |  |  |  |
|  |  |  |  | troughs. |  |  |  |
|  |  |  |  | One wavelength is equal to the distance of |  |  |  |
|  |  |  |  | one compression to another compression on |  |  |  |
|  |  |  |  | the next wave. |  |  |  |
|  | ***Central*** |  |  |  |  |  |  |
|  |  |  |  | A sound wave is an example of longitudinal |  |  |  |
|  |  |  |  | wave. |  |  |  |
|  |  |  |  | A water wave is an example of a transverse |  |  |  |
|  |  |  |  |  | wave. |  |  |  |

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|  | **Unit 4** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | | **Resources / Activities** |  |
| **(~ 13 Classes)** | | |  |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  | place |  | 4.4 Describe qualitatively the | If all waves exhibit the | The student will know that: | The student will be able to: | | CPO PFC S&P WKSHT 23.1: The |  |
|  |  | basic principles of reflection | same behavior, how do | All waves reflect when they hit a surface. |  | Define reflection. | Law of Reflection |  |
|  |  | and refraction of waves. | we use this | The normal line is 90 to the surface. |  | Define refraction. |  |  |
|  |  |  | understanding to | The angle of incident is the angle at which | Identify and define the angle of incidence. | | CPO PFC S&P WKSHT 23.1: |  |
|  | to |  |  |  |
|  |  |  | explain why sound and | the wave strikes the barrier and is measured | Identify and define the angle of reflection. | | Refraction |  |
|  | place |  |  |  |
|  |  |  | light waves bounce and | with respect to the normal line. | Identify and define the angle of refraction. | | Pinhole Viewer Lab |  |
|  | without the transfer of matter. |  | bend? | The angle of reflection is the angle at which | Explain what happens when a wave reflects | |  |
| **4. Waves***ApproximateTimeline: March* | ***Concept***: Waves carry energy from |  |  | the wave bounces off the barrier and is |  | off surface. | Shadow Lab |  |
|  |  | measured with respect to the normal line. | Explain why the angle of refraction is not | |  |
|  |  | The angle of incidence equals the angle of |  | equal to the angle of incidence when a wave | **Mirror Lab** |  |
|  |  | reflection. |  | travels from a less dense to a more dense |  |
|  |  |  |  |  |
|  |  | All waves bend when they enter a medium |  | material. | **Refraction Activity** |  |
|  |  | with a different density. | Explain why the angle of refraction is not | |  |
|  |  |  |  |
|  |  | When a wave enters a less dense material, |  | equal to the angle of incidence when a wave |  |  |
|  |  | the angle of refraction is greater than the |  | travels from a more dense to a less dense |  |  |
|  |  | angle of incidence. |  | material. |  |  |
|  |  | When a wave enters a more dense material, | Predict the angle of reflection based on the | |  |  |
|  |  | the angle of refraction is less than the angle |  | angle of incidence. |  |  |
|  |  | of incidence. | Predict the angle of refraction based on the | |  |  |
|  |  | The angle of refraction is the angle of wave |  | new medium’s density. |  |  |
|  |  | with respect to the normal line in the new | Describe what happens to the speed of a | |  |  |
|  |  | medium. |  | wave when it enters a less dense medium. |  |  |
|  | ***Central*** |  |  |  |  |  |  |
|  |  |  |  | Waves change speed when they enter a new | Describe what happens to the speed of a | |  |  |
|  |  |  |  | medium with a different density. |  | wave when it enters a more dense medium. |  |  |
|  |  |  |  | Electromagnetic waves only travel at the |  |  |  |  |
|  |  |  |  |  | speed of light in a vacuum. |  |  |  |  |

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**Physics I Curriculum Guide**

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|  | **Unit 4** | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 13 Classes)** | |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  | transfer | 4.5 Recognize that mechanical | When you speak into a | The student will know that: | The student will be able to: | Demo: Ringing bell in vacuum. |  |
|  | waves generally move faster | cup that is attached to a | Mechanical waves move at different speeds | Explain why sound does not travel in a |  |  |
|  | through a solid than through a | string, your friend who | in the different phases of matter. | vacuum. |  |  |
|  | liquid and faster through a | is holding the cup up to | Mechanical waves move fastest through | Explain why mechanical waves travel faster |  |  |
|  | the | liquid than through a gas. | his or her ear can hear | solids and slowest through gases. | in solids than in liquids and gases. |  |  |
|  |  | you. Why? | The molecular structure of matter is the | Describe the molecular structure of solids, |  |  |
|  | without |  |  |  |
|  |  |  | cause for the difference in speed. | liquids, and gases and explain how this |  |  |
|  |  |  | Solids have tightly bound molecules and | affects the speed of a mechanical wave. |  |  |
|  |  |  | transfer vibrations more easily than liquids | Explain how a guitar works. |  |  |
|  | carry energy from place to placeofmatter. |  |  |  |  |
|  |  |  | and gases. |  |  |  |
| **4. Waves***ApproximateTimeline: March* |  |  | Mechanical waves (e.g., sound) do not |  |  |  |
|  |  | travel through a medium. |  |  |  |
|  |  | When a person speaks, he or she vibrates |  |  |  |
|  |  | air. |  |  |  |
|  |  | Eardrums vibrate in response to the energy |  |  |  |
|  |  | traveling in the form of sound waves. |  |  |  |
|  |  | Sound will travel faster in a solid than in a |  |  |  |
|  |  | gas. |  |  |  |
| 4.6 Describe the apparent | Why does the pitch of | The student will know that: | The student will be able to: | Demo: Doppler Effect |  |
| change in frequency of waves | an ambulance’s siren | The frequency of a sound wave is related to | Determine the frequency of a wave by | **Doppler Effect Lab** |  |
| due to the motion of a source | sound different when it | its pitch. | measuring its wavelength and the time for |  |
| or a receiver (the Doppler | is moving toward you | High frequency sound waves have a high | one wave to occur. |  |  |
|  | Waves | effect). | then when it is moving | pitch. | Identify sound waves with a high frequency. |  |  |
|  |  | away from you? | Low frequency sound waves have a low | Identify sound waves with a low frequency. |  |  |
|  |  |  | pitch. |  |  |  |
|  | ***Concept***: |  |  | When a sound source is moving toward a |  |  |  |
|  |  |  | receiver, the sound waves bunch up and |  |  |  |
|  |  |  | have a higher frequency resulting in a |  |  |  |
|  |  |  | higher pitch. |  |  |  |
|  | ***Central*** |  |  | When a sound source is moving away from |  |  |  |
|  |  |  | a receiver, the sound waves spread out and |  |  |  |
|  |  |  | have a lower frequency resulting in a lower |  |  |  |
|  |  |  | pitch. |  |  |  |
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|  | **Unit 5** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources: Worksheets / Activities /** |  |
| **(~ 25 Classes)** | | |  |  |  |  | **Simulations** |  |
|  | ***Central Concept***: Stationary and moving charged particles result |  | 5.1 Recognize that an electric | How can you get a | The student will know that: | The student will be able to: | Electroscope Activity |  |
|  |  | charge tends to be static on | balloon to stick to a | Materials that conduct electricity are known | Identify materials that act as conductors of | **Electrophorous Activity** |  |
|  | in the phenomena known as electricity and magnetism. | insulators and can move on | wall (without taping it)? | as conductors. | electricity. |  |
|  | and in conductors. Explain |  | Materials that do not conduct electricity are | Identify materials that act as insulators of |  |  |
|  | that energy can produce a |  | known as insulators. | electricity. | Demo: Van Der Graaff |  |
|  | separation of charges. |  | Most metals are conductors of electricity. | Explain why metals conduct electricity. | Simulation: PhET – Balloons and |  |
|  |  |  | Most non-metals are non-conductors of |  |  |
|  |  |  | electricity. |  | Static Electricity |  |
| **5. Electromagnetism***ApproximateTimeline:April* |  |  | Some metals are better conductors than |  |  |  |
|  |  | others. |  |  |  |
|  |  | Metals have loose electrons which allows |  |  |  |
|  |  | charge to flow through them. |  |  |  |
| 5.2 Develop qualitative and | What do “Danger – | The student will know that: | The student will be able to: | **Build A Simple Circuit Activity** |  |
| quantitative understandings of | High Voltage” signs | Current is measured in Amps (A) and is | Define and distinguish among current, |  |  |
| current, voltage, resistance, | mean? | defined as the amount of charge moving in | voltage, and resistance. | CPO PFC S&P WKSHT 13.3: Ohm’s |  |
| and the connections among |  | 1 sec. | Identify the correct units for current, | Law |  |
| them (Ohm’s law). |  | Voltage is measured in Volts (v) and is | voltage, and resistance. | Simulation: PhET – Circuit |  |
|  |  | defined as the amount of energy in 1 | Use Ohm’s Law to calculate voltage, |  |
|  |  | coulomb of charge. | current, and resistance. | Construction Kit (DC Only) |  |
|  |  | Resistance is measured in Ohms (Ω) and is | Predict the change in current based on |  |  |
|  |  | defined as the slowing of charge. | changes in voltage and resistance. |  |  |
|  |  | Ohm’s Law relates current, voltage, and |  |  |  |
|  |  | resistance. |  |  |  |
|  |  | Ohm’s Law is: V = I x R, where V = |  |  |  |
|  |  | voltage, I = current, and R = resistance. |  |  |  |
|  |  | Current is directly related to voltage. |  |  |  |
|  |  | Current is inversely related to resistance. |  |  |  |
|  |  |  |  |  |  |  |  |  |

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|  | **Unit 5** |  |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 25 Classes)** | | |  |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  |  | electricity |  | 5.3 Analyze simple | How are the lights in a | The student will know that: | The student will be able to: | **Multimeter Activity – Series** |  |
|  | charged |  | arrangements of electrical | house wired? | A circuit is a loop of conducting material. | Identify the key components (i.e., battery, | **Circuits** |  |
|  |  | components in both series and |  | A series circuit has only one path to conduct | wire, switch, resistor, etc.) of a circuit. | **Multimeter Activity – Parallel** |  |
|  |  | parallel circuits. Recognize |  | electricity. | Draw a schematic of simple series, parallel, |  |
|  |  | symbols and understand the |  | A parallel circuit has more than one path to | and combination circuits. | **Circuits** |  |
|  | ***Central Concept***: Stationary and moving | particles result in the phenomena known as |  | functions of common circuit |  | conduct electricity. | Interpret schematics for simple series, |  |  |
| **5. Electromagnetism***ApproximateTimeline:April* |  | elements (battery, connecting |  | Most circuits are a combination of series | parallel, and combination circuits. | CPO PFC S&P WKSHT 13.2: Using |  |
|  | wire, switch, fuse, resistance) |  | and parallel circuits. | Apply Ohm’s law to simple series, parallel, | a Multimeter |  |
| and magnetism. | in a schematic diagram. |  | Circuit diagrams (schematics) can be drawn | and combination circuits. | CPO PFC S&P WKSHT 14.1: Series |  |
|  |  | using universally agreed upon symbols. | Apply the rules for series and parallel |  |
|  |  | Circuit |  |
|  |  | In a series circuit, the total voltage is equal | circuits to find voltage, current, and |  |
|  |  |  |  |
|  |  | to the sum of the voltage across each | resistance. | CPO PFC S&P WKSHT 13.3: Parallel |  |
|  |  | resistor. |  |  |
|  |  |  | Circuit |  |
|  |  | In a series circuit, the total current is the |  |  |
|  |  |  |  |  |
|  |  | same through each resistor. |  |  |  |
|  |  | In a series circuit, the total resistance is |  |  |  |
|  |  | equal to the sum of all the resistors. |  |  |  |
|  |  | In a parallel circuit, the total voltage is the |  |  |  |
|  |  | same across each resistor. |  |  |  |
|  |  | In a parallel circuit, the total current is equal |  |  |  |
|  |  | to the sum of the current through each |  |  |  |
|  |  | resistor. |  |  |  |
|  |  | In a parallel circuit, as more resistors are |  |  |  |
|  |  |  |  |  |  | added, the total resistance decreases. |  |  |  |

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|  | **Unit 5** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 25 Classes)** | | |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  | ***Central Concept***: Stationary and moving charged particles | result in the phenomena known as electricity and magnetism. | 5.4 Describe conceptually the | Why do you sometimes | The student will know that: | The student will be able to: | **Charged Tape Activity** |  |
|  | attractive or repulsive forces | get a shock when you | Like charges repel and opposite charges | Identify situations that involve attractive |  |  |
|  | between objects relative to | touch something? | attract. | electrostatic forces. | CPO PFC S&P WKSHT 15.2: |  |
|  | their charges and the distance |  | Coulomb’s Law relates the amount of | Explain how the amount of charge on an | Coulomb’s Law |  |
|  | between them (Coulomb’s |  | charge on objects and the distance between | object impacts the electrostatic force. |  |  |
|  | law). |  | them to the electrostatic force. | Explain how the separation distance | CPO PFC S&P WKSHT: 18.1: |  |
|  |  |  | The electrostatic force t is directly | between charged objects impacts the | Inverse Square Law |  |
| **5. Electromagnetism***ApproximateTimeline:April* |  |  | proportional the amount of charge on an | electrostatic force. |  |  |
|  |  | object. | Predict how the electrostatic force will be |  |  |
|  |  | The electrostatic force is proportional to the | affected by changing the amount of charge |  |  |
|  |  | inverse square of the separation distance | or the separation distance. |  |  |
|  |  | between charges. | Find the resultant electrostatic force among |  |  |
|  |  |  | charged objects. |  |  |
|  |  |  |  |  |  |
| 5.5 Explain how electric | Why is the “third rail” | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 14.3: |  |
| current is a flow of charge | so dangerous? | Electrical power is similar to mechanical | Describe the similarity between electrical | Electrical Power |  |
| caused by a potential |  | power. | and mechanical power. |  |  |
| difference (voltage), and how |  | Power is defined as the energy transferred | Calculate the power rating of appliances |  |  |
| power is equal to current |  | in a given amount of time (1 second.) | given their voltage and current. |  |  |
| multiplied by voltage. |  | Power is measured in joules/second (a.k.a., | Calculate the cost of running an appliance |  |  |
|  |  | Watts.) | for a certain amount of time. |  |  |
|  |  | Electrical bills are based on the amount of | Explain how current flows in a circuit when |  |  |
|  |  | power consumed in a given time period. | a potential difference is present. |  |  |
|  |  | Power is equal to current times voltage. |  |  |  |
|  |  | Current flows in a circuit when a voltage |  |  |  |
|  |  | difference is present. |  |  |  |
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|  | **Unit 5** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 25 Classes)** | | |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  | in |  | 5.6 Recognize that moving | How do power-locks in | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 17.3: |  |
|  |  | electric charges produce | a car work? | All magnets have a north and south pole. | Draw the magnetic field lines surrounding | Transformers |  |
|  | ***Central Concept***: Stationary and moving charged particles result |  |  |
|  |  | magnetic forces and moving |  | There are no monopole magnets. | different configurations of bar magnets. | **Make an Electromagnet Activity** |  |
|  | the phenomena known as electricity and magnetism. | magnets produce electric |  | Magnets are made up domains which | Draw the electric field lines surrounding |  |
|  | forces. Recognize that the |  | regions of aligned atoms. | different configurations of electric charges. |  |  |
|  | interplay of electric and |  | Electric charges can either be positive or | Identify the two common parts (i.e., magnet | Make a Simple Motor Activity |  |
|  | magnetic forces is the basis for |  | negative. | and coil of wire) found in speakers, |  |  |
|  | electric motors, generators, |  | All magnets are surrounded by a 3-D | microphones, motors, or electric generators. | Make a Simple Speaker Activity |  |
|  | and other technologies. |  | magnetic field. | Describe the energy transfer in a speaker, |  |  |
| **5. Electromagnetism***ApproximateTimeline:April* |  |  | Magnetic field lines point from the north | microphone, motor, or electric generator. |  |  |
|  |  | pole to the south pole. | Predict the relative strength of an |  |  |
|  |  | All electric charges are surrounded by a 3-D | electromagnet based on the number of coils |  |  |
|  |  | electric field. | present. |  |  |
|  |  | Electric field lines point from the positive | Predict the relative strength of an |  |  |
|  |  | charge to the negative charge. | electromagnet based on the current passing |  |  |
|  |  | Magnetic fields are strongest at the poles of | through the wire. |  |  |
|  |  | a magnet. | Explain how an electromagnet works. |  |  |
|  |  | Electric charges can be either negative or | Explain how a transformer can either step up |  |  |
|  |  | positive. | or step down voltage. |  |  |
|  |  | Magnetic and electric fields decrease in | Explain how a speaker and microphones |  |  |
|  |  | strength with distance. | work. |  |  |
|  |  | When a magnet is moved in and out of a | Explain how motors and electric generators |  |  |
|  |  | coil of wire, an electric field is induced in | work. |  |  |
|  |  | the wire and charge moves. | Identify and explain a real-life use of an |  |  |
|  |  | When charge moves through a wire, a | electromagnet. |  |  |
|  |  | magnetic field is induced around the wire. | Explain how a solenoid works and identify a |  |  |
|  |  | Moving charges induce magnetism. | real-life use. |  |  |
|  |  | Moving magnets induce electricity. |  |  |  |
|  |  |  |  |  | Electromagnets are temporary magnets. |  |  |  |

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|  | **Unit 6** |  | **Content Standards** | **Essential Questions** | **Student Performance Objectives (Knowledge)** | **Student Performance Objectives (Skills)** | **Resources / Activities** |  |
| **(~ 6 Classes)** | | |  |  |  |  | **(Cornerstone Activities in Bold)** |  |
|  |  |  | 6.1 Recognize that | What is light? | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 24.1: The |  |
|  |  |  | electromagnetic waves are |  | Electromagnetic waves are all light. | Explain the wave nature of light. | Electromagnetic Spectrum |  |
|  | generate |  | transverse waves and travel at |  | Electromagnetic waves travel in a vacuum. | Describe how electromagnetic radiation |  |  |
|  |  | the speed of light through a |  | Electromagnetic waves travel at the speed | travels from the Sun to the Earth. |  |  |
|  |  | vacuum. |  | of light (3.00 x 108 m/sec). | Describe an electromagnetic wave in terms |  |  |
|  |  |  |  | Electromagnetic waves are transverse | of its type and make-up. |  |  |
|  | ***Concept****:*Oscillating electric of magnetic fields can |  |  |  | waves. |  |  |  |
|  | electromagnetic waves over a wide spectrum. |  |  | Electromagnetic waves are made up of an |  |  |  |
|  |  |  | electrical component and a magnetic |  |  |  |
|  |  |  | component. |  |  |  |
| **6. Electromagnetic Radiation***ApproximateTimeline:May* |  |  | The components of an electromagnetic |  |  |  |
|  |  | wave travel at right angles to each other. |  |  |  |
|  |  |  |  |  |  |
| 6.2 Describe the | How are | The student will know that: | The student will be able to: | CPO PFC S&P WKSHT 24.1: The |  |
| electromagnetic spectrum in | electromagnetic waves | The electromagnetic spectrum is made up of | Identify the six regions of the | Electromagnetic Spectrum |  |
| terms of frequency and | used and what type of | different forms of six different forms of | electromagnetic spectrum. |  |  |
| wavelength, and identify the | information do they | light. | Explain a useful application of each of the |  |  |
| locations of radio waves, | carry? | The six different forms of light are radio | regions of the electromagnetic spectrum. |  |  |
| microwaves, infrared |  | waves, microwaves, infrared waves, visible | Classify the regions of the electromagnetic |  |  |
| radiation, visible light (red, |  | light, ultraviolet rays, x-rays, and gamma | spectrum by energy, wavelength, and |  |  |
| orange, yellow, green, blue, |  | rays. | frequency. |  |  |
| indigo, and violet), ultraviolet |  | Electromagnetic waves all travel at the |  |  |  |
| rays, x-rays, and gamma rays |  | same speed but are distinguishable by their |  |  |  |
| on the spectrum. |  | frequency. |  |  |  |
|  |  | High-energy electromagnetic waves |  |  |  |
|  |  | (gamma rays) have a higher frequency than |  |  |  |
|  | ***Central*** |  |  |  | low-energy electromagnetic waves (radio |  |  |  |
|  |  |  |  | waves.) |  |  |  |
|  |  |  |  | Electromagnetic waves with high |  |  |  |
|  |  |  |  | frequencies have short wavelengths. |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  | Electromagnetic waves with low |  |  |  |
|  |  |  |  |  | frequencies have long wavelengths. |  |  |  |

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| **MCAS Prep** | *Approximate Timeline: May* | (~ 5 Classes) |
| **of Year Science, Technology,** | **and Engineering Project***ApproximateTimeline:June* | (~ 5 Classes) |
| **End** |  |  |

**Physics I Curriculum Guide**

Each year, the Introductory Physics MCAS is administered for two days during the first week of June. For the 2010- MCAS Review Packet: 1. Motion and Forces 2011 school year, the test will be administered on Wed, June 1 and Thu, June 2, 2011.



MCAS Review Packet: 2. Conservation of Energy and Momentum MCAS Review Packet: 3. Heat and Heat Transfer

MCAS Review Packet: 4. Waves

MCAS Review Packet: 5. Electromagnetism

MCAS Review Packet: 6. Electromagnetic Radiation

S **Soda Bottle Rocket Project** cience seeks to understand the natural world, and often needs new tools to help discover the answers.

Technologies (products and processes) are the result of engineered design which are created by technicians to solve societal needs and wants.

Engineers use scientific discoveries to design products and processes that meet society’s needs.

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