

**HS Scope and Sequence**

**Course Overview: Conceptual Physics**

|  |
| --- |
| **Teacher: Abraham/ Bryant Year: 2019-2020** |
| **Course Enduring Understandings:*** *Standards on* ***motion and stability: forces and interactions*** *support students’ understanding of ideas related to why some objects move in certain ways, why objects change their motion, and why some materials are attracted to each other while others are not. Students are able to demonstrate their understanding by applying scientific and engineering ideas related to Newton’s second law, total momentum, conservation, system analysis, and gravitational and electrostatic forces.*
* *A focus on* ***energy*** *develops students’ understanding of energy at both the macroscopic and atomic scales that can be accounted for as either motions of particles or energy stored in fields. Energy is understood as a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system; the total change of energy in any system is always equal to the total energy transferred into or out of the system. Students apply their understanding to explain situations that involve conservation of energy, energy transfer, and tracing the relationship between energy and forces.*
* *Standards on* ***waves and their applications in technologies for information transfer support*** *students’ understanding of the physical principles used in a wide variety of existing and emerging technologies. Students are able to apply understanding of how wave properties and the interactions of electromagnetic radiation with matter can transfer information across long distances, store information, and investigate nature on many scales. They develop and use models of electromagnetic radiation, as either a wave of changing electric and magnetic fields or as particles. Students understand that combining waves of different frequencies can make a wide variety of patterns and thereby encode and transmit information. They can demonstrate their understanding by explaining how the principles of wave behavior and wave interactions with matter are used in technological devices to transmit and capture information and energy.*
 | **Course Essential Question(s):***What thought provoking questions foster learning and inquiry to get to the Enduring Understandings?* * How can one explain and predict interactions between objects and within systems of objects?
* How is energy transferred and conserved?
* How are waves used to transfer energy and send and store information?
	+ *How can understanding Physics help us in our daily lives?*
	+ *How are graphical and mathematical models created from experimental data?*
	+ *Why are assumptions and approximations important in physics? To what extent does this limit the usefulness of your results?*
	+ *How can scientific arguments be evaluated?*
	+ *How does physics explain change and constancy in the universe?*
	+ *How should scientific investigations be designed?*
	+ *How is the universe constructed from the tiny scales to the largest?*
 |
| **Course Mission Statement/North Star:****Science and Engineering Practices** (from NRC Framework):1. **Asking questions (for science) and defining problems (for engineering);** Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.
	1. Annotating open response questions in order to answer multiple-part questions
	2. Using Latin roots to help recognize new vocabulary
2. **\*Developing and using models;** Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
3. **Planning and carrying out investigations;** Plan and conduct an investigation, including deciding on the types, amount, and accuracy of data needed to produce reliable measurements, and consider limitations on the precision of the data.
	1. Designing and following a procedure
	2. Effectively isolating independent variable (designing an experiment with appropriate controls)
	3. Defining all relevant variables
	4. Use of lab ware
	5. Safety and respect for peers, teacher, and materials during a scientific experiment
4. **Analyzing and interpreting data;** Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific questions and engineering problems, using digital tools when feasible.
	1. Analysis and interpretation of AP style graphs and tables
5. **Using mathematics and computational thinking;** Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model “makes sense” by comparing the outcomes with what is known about the real world.
	1. Using excel to process experimental data
	2. Statistical analysis: mean and standard deviation
6. **\*Constructing explanations (for science) and designing solutions (for engineering);** Apply scientific reasoning, theory, and/or models to link evidence to the claims and assess the extent to which the reasoning and data support the explanation or conclusion.
7. **\*Engaging in argument from evidence;** Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence and challenging ideas and conclusions, and determining what additional information is required to solve contradictions.
8. **\*Obtaining, evaluating, and communicating information;** Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media, verifying the data when possible. (Mass Science and Technology/Engineering Framework)
	1. Writing a full lab report including an introduction, materials and methods, results, and discussion
 |
| **What are your grade level SEL Skills?**Students will be able to work independently and appropriately advocate for themselves and their learning. |
| **Final Assessment:***How will you assess independent student mastery of your course essential skills and questions? (Questions and Format)***Final exam will include a task to determine mastery of content as well as a laboratory component complete with lab write up.** |

|  |
| --- |
| **Overview** |
| **Unit** | **Content** | **Approx. Length** | **Notes/Rationale** |
| 1 | Thinking like a Physicist/Kinematics | 3 weeks  | Setting up routines and systems and laying the foundations for working on Science and Engineering Practices throughout other units. Focus on unit conversions, units of measurement, mathematical concepts like multiplying with exponents, readiness for the subject, etc. |
| 2 | Forces and Newton’s Law | 6 weeks | The focus will be on graphs as they relate to velocity, acceleratio, and force. This is the anchor unit and will have 6 weeks devoted to it to help ensure mastery.  |
| 3 | Momentum and Impulse | 4 weeks | Momentum will help support the topics learned in the forces unit to help connect and be able to identify what types of momentum and motion could potentially affect the force of an object. Momentum will bridge into the Energy unit.  |
| 4 | Energy and Conservation | 4 weeks  | Moved this unit up before Thermodynamics to account for a better understanding of energy and its forms before moving into energy transfer. Incorporate Egg Drop project here. |
| 5 | Thermodynamics and Heat Transfer | 4 weeks  | Focus on what constitutes an exothermic or endothermic reaction. How does heat transfer? |
| 6 | Electricity and Magnetism | 4 weeks | Incorporates electricity with the concept of forces. This unit introduces circuits and will help set up background information for the Waves and Sound unit. |
| 7 | Waves and Sound | 4 weeks | Focus on the principles and properties of wave behavior. Connect waves to technology that students will see in everyday life.  |
| 8 | Electromagnetic Radiation | 3 weeks | This unit will directly connect to waves and focus on the specific types of waves and circuits involved in electromagnetic radiation. |
| ***TOTAL*** |  | ***32 weeks for units 0-7******3 weeks for finals / wrap up******3 weeks of flex time\**** | \*Project Week(s)? |

**Units that have been changes/trimmed:**

* **The Energy and Conservation Unit was moved ahead of Thermodynamics unit to help support each other and connect content.**
* **Length of units were able to be kept the same to still account for a 32 week course time frame.**
* **Within each unit, Labs have been incorporated to align with the Science Department lab rubric**

|  |  |
| --- | --- |
| **Unit 1: Kinematics / Thinking like a Physicist**   | **Duration: 3 weeks** |
| **Meaning** |
| **Enduring Understandings:***What do you want students to understand? What inferences should they be able to make?** A motion diagram shows the position of an object at successive times. A particle model, an object in motion is replaced by a single point.
* A time interval is the difference between 2 time periods
* Scalars are quantities that are fully described by magnitude. Vectors are quantities that are fully described by a magnitude and direction
* Distance is how much ground an object has covered. Displacement is for away an object is from the starting position
* Position-time graphs can be used to find velocity and position of an object
* The slope of an object’s position vs. time graph is the average velocity of the object's motion
* An object's velocity is how fast it is moving in a given direction
 | **Essential Question(s):***What thought provoking questions foster learning and inquiry to get to the Enduring Understandings?* **Physicist Ready*** What are appropriate units of measurement?
* How do we convert from one unit to another?
* What are the steps when it comes to multiplying exponents?
* How do we use data and evidence to support our findings with reasoning?

**Kinematics*** How does kinematics impact on real world situations?
* What is the purpose of drawing a motion graph?
* What does the slope of a position-time graph measure?
* Why is it important to create pictorial and physical models before trying to solve equations?
* What is the difference between distance and displacement?
* How do scalars and vectors differ?
 |
| **Acquisition** |
| **Content Standards:** *(CCSS, State, national, AP)**Cross Cutting Concept***Patterns:** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. | **Skill Standards:** *(Thinking Skills, Group work skills, content-area habits, study skills, etc)***Science and Engineering Practices*** 1. Asking questions (for science) and defining problems (for engineering)
* 2. Developing and using models
* 3. Planning and carrying out investigations
* **4. Analyzing and interpreting data**
* **5. Using mathematics and computational thinking**
* 6. Constructing explanations (for science) and designing solutions (for engineering)
* 7. Engaging in argument from evidence
* 8. Obtaining, evaluating, and communicating information
 |
| **Notes/ Texts:***Students will show that they really understand by evidence of ….* 1. Race Car Lab

[Glencoe Physics: Principles and Problems © 2017](http://www.mheducation.com/prek-12/program/glencoe-physics-principles-problems-2017/MKTSP-GBO15MO.html) |

|  |  |
| --- | --- |
| **Unit 2:** **Forces and Newton’s law** | **Duration: 6 weeks** |
| **Meaning** |
| **Enduring Understandings:***What do you want students to understand? What inferences should they be able to make?** Velocity-time graphs can be used to find an object's velocity and accelerations
* Average acceleration is the slope of a velocity-time graph
* When the object's velocity and acceleration are in the same direction, the object's speed up. If they are in opposite directions the object slows down
* In motions with constant acceleration, there are relationships among the position, velocity, acceleration and time
* The acceleration due to gravity on Earth, g, is 9.8m/s2 downward
* An object that experiences a push or a pull has a force exerted on it. Force is a vector.
* Free body diagrams are used to show the forces acting on an object
* The forces acting on an object can be added using vector addition to find the net force
* Newton’s Laws
1. An object at rest will stay at rest, an object in motion will remain in motion unless acted on by an outside force
2. The Acceleration of system equals the net force acting on it, divided by its mass
3. For every action there is an opposite and equal reaction
* The Normal Force is a support force resulting from the contact of two objects
* Distinguish the qualitatively between static and kinetic friction
 | **Essential Question(s):***What thought provoking questions foster learning and inquiry to get to the Enduring Understandings?* * What would the world be like without Newton’s laws?
* What must be known about a force to predict the object motions?
* How does applying a force affect the way an object moves?
* How will an object's property affect how an object will move when a force is applied?
* What role does friction play in our daily lives?
* What situations can be explained by our knowledge of forces?
 |
| **Acquisition** |
| **Content Standards:** *(State, national, AP)***HS-PS2-1. Analyze data to support the claim that Newton’s second law of motion is a mathematical model describing change in motion (the acceleration) of objects when acted on by a net force.** HS-PS2-4. Use mathematical representations of Newton’s law of gravitation and Coulomb’s law to both qualitatively and quantitatively describe and predict the effects of gravitational and electrostatic forces between objects. | **Skill Standards:** *(Common Core, Thinking Skills, etc)***Science and Engineering Practices*** 1. Asking questions (for science) and defining problems (for engineering)
* **2. Developing and using models**
* 3. Planning and carrying out investigations
* **4. Analyzing and interpreting data**
* 5. Using mathematics and computational thinking
* 6. Constructing explanations (for science) and designing solutions (for engineering)
* 7. Engaging in argument from evidence
* **8. Obtaining, evaluating, and communicating information**
 |
| **Notes/ Texts:***Students will show that they really understand by evidence of ….* 1. Graphing Motion Lab
2. Forces in Opposite Direction Lab

[Glencoe Physics: Principles and Problems © 2017](http://www.mheducation.com/prek-12/program/glencoe-physics-principles-problems-2017/MKTSP-GBO15MO.html) |

|  |  |
| --- | --- |
| **Unit 3:** **Momentum and Impulse** | **Duration: 4 weeks** |
| **Meaning** |
| **Enduring Understandings:***What do you want students to understand? What inferences should they be able to make?** An objects’ momentum (mass in motion, vector) is equal to its mass multiplied by velocity
* Impulse is the change of momentum of an object when the object is acted upon by a force for an interval of time.
* The Law of Conservation of Momentum states that for two objects colliding in an isolated system, the total momentum before and after the collision is equal.
* Work is the transfer of energy when a force is applied over a displacement.
* Energy is the ability of a system to change itself or its environment(ability to do work)
* The work done on a system is equal to its energy over time
* Power is define the rate of energy transfer
* Law of conservation of energy states that energy cannot be created or destroy but is transferred from one form to another
* Kinetic Energy is the energy required for motion. Potential energy is the energy stored due to an object position
* The sum of Potential and Kinetic Energy is known as Mechanical Energy
 | **Essential Question(s):***What thought provoking questions foster learning and inquiry to get to the Enduring Understandings?* * What is momentum and Impulse?
* How is momentum and impulse related to one another?
* How does Newton’s Third law relate to the Law of conservation of momentum?
* *Under which conditions is momentum conserved?*
* *What is work and energy?*
* *How is work and energy related?*
* *What is Power and how does it relate to work and energy?*
* *How is a systems’ motion related to its kinetic energy?*
* *How does an objects’ position relate to its potential energy?*
* *How are mass and energy related?*
* *Under what condition is energy conserved?*
* *What is mechanical energy and how is it conserved?*
* *How is energy used in real world application?*
 |
| **Acquisition** |
| **Content Standards:** *(State, national, AP)*HS-PS2-2. Use mathematical representations to show that the total momentum of a system of interacting objects is conserved when there is no net force on the system.**HS-PS2-3. Apply scientific principles of motion and momentum to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.**HS-PS1-8. Develop a model to illustrate the energy released or absorbed during the processes of fission, fusion, and radioactive decay. | **Skill Standards:** *(Common Core, Thinking Skills, etc)***Science and Engineering Practices*** 1. Asking questions (for science) and defining problems (for engineering)
* **2. Developing and using models**
* 3. Planning and carrying out investigations
* 4. Analyzing and interpreting data
* **5. Using mathematics and computational thinking**
* **6. Constructing explanations (for science) and designing solutions (for engineering)**
* 7. Engaging in argument from evidence
* 8. Obtaining, evaluating, and communicating information
 |
| **Notes/ Texts:**1. 2D Collision Lab
2. Energy Skate Park Lab

[Glencoe Physics: Principles and Problems © 2017](http://www.mheducation.com/prek-12/program/glencoe-physics-principles-problems-2017/MKTSP-GBO15MO.html) |

|  |  |
| --- | --- |
| **Unit 4:**  **ENERGY** | **Duration: 4 weeks** |
| **Meaning** |
| **Enduring Understandings:***What do you want students to understand? What inferences should they be able to make?** A system is an object or objects of interest that can interact with each other and with the outside world
* Energy is the capacity to do work, measured in Joules and often released as thermal energy(heat). Energy cannot be created or destroyed, it is transferred from one form to another(law of conservation of energy)
* Kinetic energy is the energy due to motion
* Potential energy is the energy stored in an object due to its position. It has two forms: Elastic potential and Gravitational potential energy
* Mechanical energy is the sum of potential and kinetic energy within a system
 | **Essential Question(s):***What thought provoking questions foster learning and inquiry to get to the Enduring Understandings?* * What is a system?
* How is work and energy related to one another?
* If energy cannot be created or destroyed, where does it come from? Where does it go?
* How does kinetic energy and potential energy relate to each other?
* What forms can energy take on?
* How does electrical energy differ from electromagnetic energy?
* How is mass related to energy?
 |
| **Acquisition** |
| **Content Standards:** *(State, national, AP)***HS-PS3-1. Use algebraic expressions and the principle of energy conservation to calculate the change in energy of one component of a system when the change in energy of the other component(s) of the system, as well as the total energy of the system including any energy entering or leaving the system, is known. Identify any transformations from one form of energy to another, including thermal, kinetic, gravitational, magnetic, or electrical energy, in the system.** **HS-PS3-2. Develop and use a model to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles and objects or energy stored in fields.**HS-PS3-3. Design and evaluate a device that works within given constraints to convert one form of energy into another form of energy. | **Skill Standards:** *(Common Core, Thinking Skills, etc)***Science and Engineering Practices*** 1. Asking questions (for science) and defining problems (for engineering)
* **2. Developing and using models**
* **3. Planning and carrying out investigations**
* 4. Analyzing and interpreting data
* **5. Using mathematics and computational thinking**
* 6. Constructing explanations (for science) and designing solutions (for engineering)
* 7. Engaging in argument from evidence
* 8. Obtaining, evaluating, and communicating information
 |
| **Notes/ Texts:**1. The Ramp Lab
2. Egg Drop Lab/ Project

[Glencoe Physics: Principles and Problems © 2017](http://www.mheducation.com/prek-12/program/glencoe-physics-principles-problems-2017/MKTSP-GBO15MO.html) |

|  |  |
| --- | --- |
| **Unit 5: Heat and Heat Transfer** | **Duration: 4 weeks** |
| **Meaning** |
| **Enduring Understandings:***What do you want students to understand? What inferences should they be able to make?** Heat is the transfer of thermal energy that occurs spontaneously from a warmer object to a cooler object. Thermal energy is the sum of kinetic and potential energies of particles that make up an object
* Temperature is the average kinetic energy per particle in an object. Absolute Zero is the coldest theoretical temperature ( 0 kelvin or -273 Celsius)
* There are 3 heat transfer method: Conduction, Radiation, Convection
* Thermal equilibrium is a state at which the rate of thermal energy transfer between two objects are equal
* Thermometers are used to measure temperature by using thermal equilibrium
* Specific Heat of a material is the amount of energy must be added to a unit of mass of a material to raise its temperature by 1 degree Celsius
* Entropy is a measure of disorder in a system
* Laws of Thermodynamics States
	+ 1st law-that energy cannot be created or destroyed it is transferred from one form to another
	+ 2nd law of Thermodynamics state that the total entropy of an isolated system cannot decrease overtime
	+ 3rd Law of Thermodynamics State that a system can never reach absolute zero
 | **Essential Question(s):***What thought provoking questions foster learning and inquiry to get to the Enduring Understandings?* * How does temperature and thermal energy differ from one another?
* Describe what will happen to a system as it reaches absolute zero?
* How is thermal energy transferred between objects?
* Why does specific heat depend on the material of an object?
* How does the first law of thermodynamics relate to the law of conservation of energy?
* How do engines, heat pump & refrigerators exhibit the first law of thermodynamics?
* How does the arrangement of molecules determine the state of matter?
 |
| **Acquisition** |
| **Content Standards:** *(State, national, AP)*HS-PS3-4a. Provide evidence that when two objects of different temperature are in thermal contact within a closed system, the transfer of thermal energy from higher temperature objects to lower-temperature objects results in thermal equilibrium, or a more uniform energy distribution among the objects and that temperature changes necessary to achieve thermal equilibrium depend on the specific heat values of the two substances | **Skill Standards:** *(Common Core, Thinking Skills, etc)***Science and Engineering Practices****1. Asking questions (for science) and defining problems (for engineering)*** 2. Developing and using models
* **3. Planning and carrying out investigations**
* 4. Analyzing and interpreting data
* 5. Using mathematics and computational thinking
* 6. Constructing explanations (for science) and designing solutions (for engineering)
* 7. Engaging in argument from evidence
* **8. Obtaining, evaluating, and communicating information**
 |
| **Notes/ Texts:**1. State of Matter lab
2. Energy forms and Changes Lab

[Glencoe Physics: Principles and Problems © 2017](http://www.mheducation.com/prek-12/program/glencoe-physics-principles-problems-2017/MKTSP-GBO15MO.html) |

|  |  |
| --- | --- |
| **Unit 6: Electricity and Magnetism**  | **Duration: 4 weeks** |
| **Meaning** |
| **Enduring Understandings:***What do you want students to understand? What inferences should they be able to make?** Similar electric charges repel and opposite electric charges attract
* Electrostatic is the study of electric charges. Electric charge is a physical quantity of matter. There are 3 types of charges: Positive, negative and neutral.
* An insulator is a material that doesn’t allow for an easy flow of electric charges
* A conductor is a material that allows electric charges to move freely
* Coulomb's law states that the magnitude of electrostatic force is proportional to the charges divided by the distance squared
* Electrostatic force decreases as the distance between charges increase
* Electric field is a property of a space around a charged object that exerts forces over other charge particles. Electric Field lines represent the magnitude of force and always point from positive to negative
* Electric potential difference is also known as voltage
* Electric current is a flow of electric charges. Electric circuit is any closed loop or conducting path that allows for the flow of electric charges
* Ohm’s laws state voltage is proportional to the product of current and resistance
* Resistance is a measure of how strong an object can impede current
* Parallel Circuits is a circuit that has multiple pathways/branches for current to travel
* Series circuit has a singular path for current to travel
* Magnets and Electric current produce a magnetic field. Magnets have opposite ends called poles: North & South. Similar poles repel and opposite poles attract. Magnetic fields are the fields that exist in a space where magnets would experience a force.
* Domain is a group of neighboring atoms with poles aligned in the same direction
* Electromagnetic is a magnet created by the flow of electric charges
* A solenoid is a spiral/loop coil wire carrying an electric charge
 | **Essential Question(s):***What thought provoking questions foster learning and inquiry to get to the Enduring Understandings?* * How do charged objects interact with one another?
* How do insulators differ from conductors?
* What is the mathematical relationship between electrostatic force, charge & the distance between charges?
* Where does an electric field exist?
* In what directions do electric field lines point?
* What is another name for electric potential difference?
* How is voltage, current & resistance related?
* What is Ohm’s law?
* How are Series and Parallel circuits different from one another?
* How are magnets and electric charges similar?
* How do magnetism and electricity relate?
* What is a domain?
* What is the smallest and biggest magnet in the world?
* How can a magnet be made from an electric current? Vice versa?
* What is a magnetic field?
* How are electro-magnets made?
* What happens to a magnet if it is broken in half?
 |
| **Acquisition** |
| **Content Standards:** *(State, national, AP)*HS-PS2-5. Provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. HS-PS2-9(MA). Evaluate simple series and parallel circuits to predict changes to voltage, current, or resistance when simple changes are made to a circuit. **HS-PS2-10(MA). Use free-body force diagrams, algebraic expressions, and Newton’s laws of motion to predict changes to velocity and acceleration for an object moving in one dimension in various situations.**HS-PS3-5. Develop and use a model of magnetic or electric fields to illustrate the forces and changes in energy between two magnetically or electrically charged objects changing relative position in a magnetic or electric field, respectively. | **Skill Standards:** *(Common Core, Thinking Skills, etc)***Science and Engineering Practices*** 1. Asking questions (for science) and defining problems (for engineering)
* **2. Developing and using models**
* 3. Planning and carrying out investigations
* 4. Analyzing and interpreting data
* 5. Using mathematics and computational thinking
* **6. Constructing explanations (for science) and designing solutions (for engineering)**
* 7. Engaging in argument from evidence
* 8. Obtaining, evaluating, and communicating information
 |
| **Notes/ Texts:**1. Energy Skate park Lab
2. Faraday's Electromagnetic Lab

[Glencoe Physics: Principles and Problems © 2017](http://www.mheducation.com/prek-12/program/glencoe-physics-principles-problems-2017/MKTSP-GBO15MO.html) |

|  |  |
| --- | --- |
| **Unit 7:**  **Waves and Sound**  | **Duration: 4 weeks** |
| **Meaning** |
| **Enduring Understandings:***What do you want students to understand? What inferences should they be able to make?** Periodic motion repeats in a regular cycle. A Period is the time is takes for an object to repeat one complete cycle of motion
* Amplitude of motion is the maximum distance the object moves away from the equilibrium position
* Simple harmonic Motion is any system in which the force acting to restore an object to its equilibrium position is directly proportional to the displacement
* Hooke’s Law is used to determine the force acting on a spring
* An example of Simple Harmonic Motion can be observed by the swinging of a pendulum
* Resonance occurs when forces are applied to a vibrating object at time interval equal to the period of oscillation
* A wave is a disturbance that carries energy through matter or space. A wave pulse is a single bump or disturbance
* Mechanical and Electromagnetic are the two types of waves. The two types of mechanical wave are longitudinal (displacement is parallel to the direction of motion) and Transverse(displacement is perpendicular to the direction of motion. Trough is the lowest point of a transverse wave and Crest is the highest point.
* A phase is any two points(same position moving in the same direction) on a wave that are one or more wavelength apart
* The frequency of a wave is the number of complete oscillations a point on that wave makes each second
* Frequency and period are inversely proportionally to each other
* Wave speed = frequency x wavelength
* Law of reflection pertains to wave behavior. Reflection is the bending of a wave at the boundary. Refraction is the bending of a wave as it crosses a boundary
* Sound waves are pressure oscillations that are transmitted through matter. Pitch is the highness or lowness of a sound. The most common unit of measurement for sound are decibels. Sound waves travel fastest through a solid and slowest through a gas
* The Doppler effect is a change in frequency of sound caused by the movement of either the source or the detector
 | **Essential Question(s):***What thought provoking questions foster learning and inquiry to get to the Enduring Understandings?* * *What is simple harmonic motion?*
* *How is period and frequency related?*
* *How much energy is stored in a spring?*
* *What affects a pendulum's period?*
* *What is Hooke’s Law?*
* *What is resonance?*
* *What is a wave?*
* *What are the two kinds of waves? How do they compare to one another?*
* *What are the two types of mechanical waves? How do they compare to each other?*
* *What does it mean for two waves to be in phase?*
* *How are frequency, wavelength and wave speed related?*
* *What is the relationship between frequency and period?*
* *How is pitch and frequency related?*
* *What is the Law of reflection?*
* *What is refraction?*
* *How do waves interact at a boundary?*
* *How do waves behave based on the state of matter?*
 |
| **Acquisition** |
| **Content Standards:** *(State, national, AP)*HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling within various media. Recognize that electromagnetic waves can travel through empty space (without a medium) as compared to mechanical waves that require a medium.**HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.** | **Skill Standards:** *(Common Core, Thinking Skills, etc)***Science and Engineering Practices*** 1. Asking questions (for science) and defining problems (for engineering)
* 2. Developing and using models
* 3. Planning and carrying out investigations
* 4. Analyzing and interpreting data
* **5. Using mathematics and computational thinking**
* 6. Constructing explanations (for science) and designing solutions (for engineering)
* 7. Engaging in argument from evidence
* **8. Obtaining, evaluating, and communicating information**
 |
| **Notes/ Texts:**1. Waves on a String Lab
2. Sound lab

[Glencoe Physics: Principles and Problems © 2017](http://www.mheducation.com/prek-12/program/glencoe-physics-principles-problems-2017/MKTSP-GBO15MO.html) |

|  |  |
| --- | --- |
| **Unit 8:**  **Electromagnetic Radiation** | **Duration: 3 weeks** |
| **Meaning** |
| **Enduring Understandings:***What do you want students to understand? What inferences should they be able to make?** Light waves travel in a straight line and can only change directions when they encounter a boundary. The duality of light acts as both a wave and a particle. Light can easily travel through transparent materials. Some light can travel through translucent materials and no light can travel through opaque materials. Light can only be a transverse wave.Like all waves light can be diffracted, has a frequency, wavelength and can be Doppler Shifted.
* Electromagnetic radiation can travel through a vacuum and doesn’t require a medium
* The speed of light in a vacuum is 3 x 108 m/s
* Diffraction is known as the bending of light at the edge of a boundary
* Colors are determined by the different frequency/ wavelengths of Light
* The electromagnetic spectrum includes: radio, microwaves, infrared waves, visible light, ultra violet, x-ray and gamma wave
* Polarization is the production of light with a specific direction of oscillation
* Mirrors can be used to reflect an image. Concave mirrors make the virtual image smaller than the real image. Convex mirrors make the virtual image larger than the real image.
* The amount of refraction at a boundary depends on the indices of refraction of the two mediums and the angle of incidences
* Mirages are formed due to the refraction of light
 | **Essential Question(s):***What thought provoking questions foster learning and inquiry to get to the Enduring Understandings?* * *What is the duality of light?*
* *Can light travel through transparent, translucent and Opaque materials?*
* *What kind and type of wave is light?*
* *How do electromagnetic waves compare to mechanical waves?*
* *What is diffraction?*
* *Can light travel in space? Why?*
* *What is the speed of light?*
* *What wave properties can we observe in light?*
* *How is the color of an object determined?*
* *How is the electromagnetic spectrum separated?*
* *What does it mean to polarize light?*
* *What is the difference between convex, concave and plane mirrors?*
* *What is the difference between refraction and diffraction?*
* *Why do Mirages form?*
* *What does an object's color tell us about that material?*
 |
| **Acquisition** |
| **Content Standards:** *(State, national, AP)*HS-PS2-5. Provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described by either a wave model or a particle model, and that for some situations involving resonance, interference, diffraction, refraction, or the photoelectric effect, one model is more useful than the other.  | **Skill Standards:** *(Common Core, Thinking Skills, etc)***Science and Engineering Practices*** 1. Asking questions (for science) and defining problems (for engineering)
* 2. Developing and using models
* 3. Planning and carrying out investigations
* **4. Analyzing and interpreting data**
* 5. Using mathematics and computational thinking
* 6. Constructing explanations (for science) and designing solutions (for engineering)
* 7. Engaging in argument from evidence
* 8. Obtaining, evaluating, and communicating information
 |
| **Notes/ Texts:**1. Color Vision Lab
2. Bending Light Lab

[Glencoe Physics: Principles and Problems © 2017](http://www.mheducation.com/prek-12/program/glencoe-physics-principles-problems-2017/MKTSP-GBO15MO.html) |