POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Integrated Science	**GRADE(S): 12**
UNIT 1: Forces	**TIMEFRAME: 6 weeks**

PA ACADEMIC STANDARDS

3.2.12.A - **Physical Sciences: Chemistry and Physics ~ Chemistry**

3.2.12.A.1.
- Compare and contrast colligative properties of mixtures. Compare and contrast the unique properties of water to other liquids.

3.2.12.A. 2.
- Distinguish among the isotopic forms of elements. Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus. Explain how light is absorbed or emitted by electron orbital transitions.

3.2.12.A. 3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation E=mc2.

3.2.12.A. 4.
- Apply oxidation/reduction principles to electrochemical reactions. Describe the interactions between acids and bases.

3.2.12.A. 5.
- MODELS/PATTERNS Use VSEPR theory to predict the molecular geometry of simple molecules. CONSTANCY AND CHANGE Predict the shift in equilibrium when a system is subjected to a stress.

3.2.12.B - **Physical Sciences: Chemistry and Physics ~ Physics**

3.2.12.B. 1.
- Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.

3.2.12.B. 2.
- Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.

3.2.12.B. 3.
- Describe the relationship between the average kinetic molecular energy, temperature, and phase changes.

3.2.12.B. 4.
- Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.

3.2.12.B. 5.
- Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.

3.2.12.B. 6.
- CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

KEY CONCEPTS:

Force, mass, and acceleration are interdependent. A change in any one of these affects the others.
Knowledge of the conditions of an object's motion allows us to predict their future.
Friction is an ever present force that opposes motion.

OBJECTIVES / ESSENTIAL KNOWLEDGE:

1. Explain how forces affect the motion of an object.
    a. A force can cause a resting object to move or it can accelerate a moving object by changing the object's speed or direction
    b. When the forces on an object are balanced there is no change in the objects motion. When an unbalanced force acts on an object the object accelerates
2. Define the four main types of friction.
    a. Static Friction- is the friction force that acts on objects that are not moving. Static friction always acts in the direction opposite to that of the applied force
    b. Sliding Friction-is a force that opposes the direction of motion of an object as it slides over a surface.
    c. Rolling Friction-a friction force that acts on rolling objects caused by the change in shape at the point of rolling contact
    d. Fluid Friction- The force of fluid friction opposes the motion of an object through a fluid
3. Explain how gravity and air resistance would affect a falling object.
    a. Earth's gravity acts downward toward the center of Earth. Gravity causes objects to accelerate downward, whereas air resistance acts in the direction opposite to the motion and reduces acceleration
    b. The combination of initial forward velocity and downward vertical forces of gravity cause a projectile to follow a curved path.
4. Explain how pressure is calculated
    a. To calculate pressure, divide the force by the area over which the force acts
    b. Air pressure decreases as altitude increases
5. Describe the relationship between the depth of water and the pressure it exerts.
    a. Water pressure increases as depth increases. The pressure in a fluid at any given depth is constant, and it is exerted equally in all directions
    b. The amount of pressure exerted by a fluid depends on the type of fluid and the depth
6. Explain how Pascal's principle describes the transmission of pressure through a fluid.
    a. According to Pascal's principle, a change in pressure at any point in a fluid is transmitted equally and unchanged in all directions throughout the fluid
7. Explain how a hydraulic system is able to increase forces.
    a. A hydraulic system is a device that uses pressurized fluid action on pistons of different sizes to change a force.
    b. In a hydraulic lift system, an increased output force is produced by a constant fluid pressure exerted on the larger area of the output piston
8. Describe the relationship between fluid speed and fluid pressure.
    a. According to Bernoulli,s Principle, as the speed of a fluid increases, the pressure with the fluid decreases.
9. Define buoyancy and explain the effect of buoyancy on the apparent weight of an object
    a. Buoyancy is the ability of a fluid to exert an upward force on an object placed in it
    b. Buoyancy results in the apparent loss of weight of an object in a fluid
    c. If an object is less dense than the fluid it is in, it will float. If the object is more dense than the fluid it is in, it will sink.
    d. When the buoyant force is equal to the weight, an object floats or is suspended. When the buoyant forces is less than the weight , the object sinks

ACTIVITIES:	**ASSESSMENTS:**
	REMEDIATION:
RESOURCES:	**ENRICHMENT:**

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Integrated Science	**GRADE(S): 12**
UNIT 2: Motion	**TIMEFRAME: 6 weeks**

PA ACADEMIC STANDARDS:

3.2.12.A - **Physical Sciences: Chemistry and Physics ~ Chemistry**

3.2.12.A.1.
- Compare and contrast colligative properties of mixtures. Compare and contrast the unique properties of water to other liquids.

3.2.12.A. 2.
- Distinguish among the isotopic forms of elements. Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus. Explain how light is absorbed or emitted by electron orbital transitions.

3.2.12.A. 3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation E=mc2.

3.2.12.A. 4.
- Apply oxidation/reduction principles to electrochemical reactions. Describe the interactions between acids and bases.

3.2.12.A. 5.
- MODELS/PATTERNS Use VSEPR theory to predict the molecular geometry of simple molecules. CONSTANCY AND CHANGE Predict the shift in equilibrium when a system is subjected to a stress.

3.2.12.B - **Physical Sciences: Chemistry and Physics ~ Physics**

3.2.12.B. 1.
- Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.

3.2.12.B. 2.
- Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.

3.2.12.B. 3.
- Describe the relationship between the average kinetic molecular energy, temperature, and phase changes.

3.2.12.B. 4.
- Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.

3.2.12.B. 5.
- Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.

3.2.12.B. 6.
- CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

KEY CONCEPTS

- Force, mass, and acceleration are interdependent. A change in any one of these affects the others.
- Knowledge of the conditions of an object's motion allows us to predict their future.
- Friction is an ever present force that opposes motion.
- For gaseous substances, pressure, volume, and temperature are interdependent.
- Whenever one object exerts a force on another other, an equal amount of force is exerted back on it.

OBJECTIVES / ESSENTIAL KNOWLEDGE

1. Describe and analyze the motion of an object in terms of position, time, velocity and acceleration.
    - An object is in motion if it changes position relative to a reference point
    - Motion can be described by distance, speed, displacement, where displacement and velocity also include direction
    - Velocity of an object is the speed of the object and the direction of its motion
    - The speed of an object can be calculated by dividing the distance traveled by the time needed to travel the distance
    - Acceleration is the change in velocity divided by the time it takes for the change to occur
    - Acceleration occurs whenever an object speeds up, slows down, or changes direction
2. Relate the motion of objects to a frame of reference.
    - To describe motion accurately and completely, a frame of reference is necessary. A frame of reference is a system of objects that are not moving in respect to one another.
3. Describe the relationship between force, mass, and acceleration.
    - A force is a push or pull. The net force of an object is the combination of all the forces acting on the object. The forces acting on the object can be balanced or unbalanced. If the forces are balanced the net force is zero
    - The mass of an object affects how easy it is to change its motion. Mass is the amount of matter in an object. The tendency of an object to resist a change in its motion is inertia. They amount of resistance to a change in motion increases as an object's mass increases.
4. Use Newton's first law to explain the motion of an object.
    - According to Newton's first law of motion- often called the law of inertia states if the net force acting on an object is zero the object will remain at rest, if the object is already moving it will continue to move in a straight line with constant speed
5. Using Newton's second law, relate the force, mass, and acceleration of an object.
    - A moving object slows down if the net force is in the direction opposite to the motion
    - A moving object speeds up if the net force is in the direction of the motion
    - A moving object turns if the net force is at an angle to the direction of motion
6. Explain that forces act in pairs as described by Newton's third law.
    - According to Newton's third law, when one object exerts a force on another object, the second object exerts the same size force on the first object
    - Either force in an action-reaction force pair can be the action force or the reaction forces.
    - Action and reaction force pairs do no cancel because they are exerted on different objects
    - When action and reaction forces are exerted by two objects, the accelerations of the objects depend on the masses of the objects
7. Relate the strength of the gravitational force to the distance between two objects and the mass of the objects (i.e., Newton's law of universal gravitation).
    - A falling object is in free fall if the only force acting on it is gravity
    - Weightlessness occurs in free fall when the weight of an object seems to be zero
    - Objects orbiting Earth appear to be weightless because they are in free fall in a curved path around Earth

ACTIVITIES:	**ASSESSMENTS:**
1. Calculate the average velocity of a moving object using data obtained from measurements of position of the object at two or more times. 2. Distinguish between distance and displacement. 3. Distinguish between speed and velocity. 4. Determine and compare the average and instantaneous velocity of an object from data showing its position at given	**REMEDIATION:** **ENRICHMENT:**

times.

5. Collect, graph, and interpret data for position vs. time to describe the motion of an object and compare this motion to the motion of another object.
6. Determine the average acceleration of an object from data showing velocity at given times.
7. Describe the velocity of an object when its acceleration is zero.
8. Collect, graph, and interpret data for velocity vs. time to describe the motion of an object.
9. Describe the acceleration of an object moving in a circular path at constant speed (i.e., constant speed, but changing direction).
10. Analyze the velocity and acceleration of an object over time.
11. Compare the motion of an object relative to two frames of reference.
12. Predict the motion of an object relative to a different frame of reference (e.g., an object dropped from a moving vehicle observed from the vehicle and by a person standing on the sidewalk).
13. Describe how selecting a specific frame of reference can simplify the description of the motion of an object.
14. Describe the motion of a moving object on which balanced forces are acting.
15. Describe the motion of a stationary object on which balanced forces are acting.
16. Describe the balanced forces acting on a moving object commonly encountered (e.g., forces acting on an automobile moving at constant velocity, forces that maintain a body in an upright position while walking).
17. Observe and describe forces encountered in everyday life (e.g., braking of an automobile - friction, falling rain drops - gravity, directional compass - magnetic, bathroom scale - elastic or spring).
18. Determine the relationship between the net force on an object and the object's acceleration.

RESOURCES:

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Integrated Science	**GRADE(S): 12**
UNIT 3: Work, Power and Machines	**TIMEFRAME: 8 weeks**

PA ACADEMIC STANDARDS:

3.2.12.A - **Physical Sciences: Chemistry and Physics ~ Chemistry**

3.2.12.A.1.
- Compare and contrast colligative properties of mixtures. Compare and contrast the unique properties of water to other liquids.

3.2.12.A.2.
- Distinguish among the isotopic forms of elements. Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus. Explain how light is absorbed or emitted by electron orbital transitions.

3.2.12.A.3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation E=mc2.

3.2.12.A.4.
- Apply oxidation/reduction principles to electrochemical reactions. Describe the interactions between acids and bases.

3.2.12.A.5.
- MODELS/PATTERNS Use VSEPR theory to predict the molecular geometry of simple molecules. CONSTANCY AND CHANGE Predict the shift in equilibrium when a system is subjected to a stress.

3.2.12.B - **Physical Sciences: Chemistry and Physics ~ Physics**

3.2.12.B.1.
- Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.

3.2.12.B.2.
- Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.

3.2.12.B.3.
- Describe the relationship between the average kinetic molecular energy, temperature, and phase changes.

3.2.12.B.4.
- Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.

3.2.12.B.5.
- Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.

3.2.12.B.6.
- CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

KEY CONCEPTS:

Work is the quantity of energy transferred by a force when it is applied to a body and causes that body to move in the direction of the force. Work is done only when an object experiences a change in its motion; energy can be present in an object or a system when nothing has happened at all but it can only be observed when it is transferred from one object or system to another.

OBJECTIVES / ESSENTIAL KNOWLEDGE

1. Define and explain the relationship between work and power.

- Work is done when a force causes an object to move in the same direction that the force is applied
- If there is no movement, no work is done
- Work can be calculated by multiplying the force applied by the distance
- Power is how quickly work is done
- Power can be calculated by dividing the work done by the time needed to do the work
- A common unit of power is the horsepower. One horsepower is equal to about 746 watts.

2. Calculate the mechanical advantages and efficiency of a machine.
   - A machine is a device that changes a force. Machines make work easier to do. They change the size of a force needed, the direction of a force, or the distance over which a force acts.
   - Work output (done by machine) is always less than work input (done on the machine)
   - The mechanical advantage of a machine is the number of times the machine increases the input force
   - The efficiency of a machine is the ration of the output work to the input work
3. Distinguish among the different simple machines
   - A simple machine is a machine that does work with only one movement
   - Simple machines include: incline plane, wedge, screw, lever, wheel and axle, pulley
     a. An inclined plane is a flat, sloped surface. Less forces is needed to move an object from one height to another using and inclined plane than is needed to lift an object (ramp)
     b. Wedge- an inclined plane that moves is called a wedge (knife, door stop, axe)
     c. Screw- A screw is and inclined plane wrapped around a cylinder or post. The inclined plane on the screw forms the screw threads. When you turn the screw, the force applied is changed by the threads to a force that pulls the screw into the material
     d. Lever-A lever is any rigid rod or plank that pivots, or rotates, about a point. The point about which the lever pivots is called a fulcrum.
     e. Wheel and Axle- A wheel and axle consists of two circular objects of different sizes that are attached in such a way that they rotate together.
     f. Pulley- a pulley consists of a grooved wheel with a rope or cable wrapped over it.

ACTIVITIES:	**ASSESSMENTS:**
RESOURCES:	**REMEDIATION:**
	ENRICHMENT:

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Integrated Science	**GRADE(S): 12**
UNIT 4: Energy	**TIMEFRAME: 6 weeks**

PA ACADEMIC STANDARDS

3.2.12.A - **Physical Sciences: Chemistry and Physics ~ Chemistry**

3.2.12.A.1.
- Compare and contrast colligative properties of mixtures. Compare and contrast the unique properties of water to other liquids.

3.2.12.A.2.
- Distinguish among the isotopic forms of elements. Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus. Explain how light is absorbed or emitted by electron orbital transitions.

3.2.12.A.3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation E=mc2.

3.2.12.A.4.
- Apply oxidation/reduction principles to electrochemical reactions. Describe the interactions between acids and bases.

3.2.12.A.5.
- MODELS/PATTERNS Use VSEPR theory to predict the molecular geometry of simple molecules. CONSTANCY AND CHANGE Predict the shift in equilibrium when a system is subjected to a stress.

3.2.12.B - **Physical Sciences: Chemistry and Physics ~ Physics**

3.2.12.B.1.
- Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.

3.2.12.B.2.
- Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.

3.2.12.B.3.
- Describe the relationship between the average kinetic molecular energy, temperature, and phase changes.

3.2.12.B.4.
- Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.

3.2.12.B.5.
- Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.

3.2.12.B.6.
- CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

KEY CONCEPTS:

1. Transformations of energy usually release some energy typically in the form of heat.
2. Thermal energy flows from areas of higher temperature to areas of lower temperature.
3. Heat transfer occurs by conduction, convection, or radiation into cooler places.
4. Temperature can change as heat is being transferred.
5. Nuclear reactions convert matter into energy through the process of radioactive decay, fission and fusion.
6. Nuclear energy has great potential for practical applications.

OBJECTIVES / ESSENTIAL KNOWLEDGE:

1. Differentiate among the various forms of energy and recognize that they can be transformed from one form to others.
    - Energy can be converted from one form to another. The process of changing energy from one form to another is energy conversion
    - The law of conservation of energy states that energy cannot be created or destroyed
    - The major forms of energy are mechanical, thermal, chemical, electrical, electromagnetic, and nuclear energy
        a. Mechanical energy is the energy associated with the motion and position of everyday objects
        b. Thermal energy is the total potential and kinetic energy of all the microscopic particles in an object. When an object's atoms move faster, its thermal energy increases and the object becomes warmer
        c. Chemical energy is the energy stored in chemical bonds. When the bonds are broken, the released energy can do work
        d. Electrical energy is the energy associated with electric charges. Electric charges can exert forces that do work
        e. Electromagnetic energy is a form of energy that travels through space in the form of waves.
        f. Nuclear energy is the energy stored in atomic nuclei
2. Describe how changes in the nucleus of an atom during a nuclear reaction
    - Nuclear fission is a process that releases energy by splitting nuclei apart
    - Nuclear fusion releases energy when less massive nuclei combine to form a more massive nucleus
3. Distinguish between examples of kinetic and potential energy (i.e., gravitational) within a system
    - The gravitational potential energy of an object is converted to the kinetic energy of motion as the object falls
    - Conversion between kinetic and potential energy can happen in both directions, from kinetic to potential or from potential to kinetic
4. Describe the relationship between energy and mass
    - Einstein's equation shows that energy and mass are equivalent and can be converted into each other- In other words- Energy is released as matter is destroyed and matter can be created from energy
5. List the major nonrenewable and renewal sources of energy and describe how energy resources can be conserved.
    - Nonrenewable energy resources include oil, natural gas, coal, and uranium
    - Renewable energy resources include hydroelectric, solar, geothermal, wind, biomass, and possibly in the future nuclear fusion
    - Energy resources can be conserved by reducing energy needs and increasing the efficiency of energy use
6. Differentiate between thermal energy, heat and temperature.
    - The thermal energy of an object is the sum of the kinetic and potential energy of all the molecules in an object
    - Thermal energy depends on the mass, temperature, and phase (solid, gas, liquid) of an object. Thermal expansion occurs because particles of matter tend to move further apart as temperature increases
    - Heat is the transfer of thermal energy due to a temperature difference
    - Heat flows spontaneously from hot objects to cold objects
    - Temperature is a measure of the average value of the kinetic energy of the molecules in random motion
7. Interpret examples of heat transfer (e.g., home heating, solar panels) as convection, conduction, or radiation
    - Conduction is the transfer of thermal energy when substances are in direct contact
    - Conduction in gases is slower than in liquids and solids because the particles in a gas collide less often
    - Radiation is the transfer of thermal energy by electromagnetic waves
    - All objects radiate energy. As an object's temperature increases, the rate at which it radiates energy increases

- Convection is the transfer of thermal energy by the movement of matter
- Convention currents are important in many natural cycles, such as ocean currents, weather systems, and movements of hot rock in Earth's interior

8. Differentiate between the properties of thermal conductors and insulators
    - A thermal conductor is a material that conducts thermal energy well. Metal conducts thermal energy quickly.
    - Thermal energy does not flow easily in an insulator easily. For example, wood and air are good insulators.
9. Provide details for each of the three laws of thermodynamics.
    - The first law of thermodynamics states that energy is conserved
    - The second law of thermodynamics states that thermal energy can flow form colder objects to hotter objects only if work is done on the system
    - The third law of thermodynamics states that absolute zero cannot be reached

ACTIVITIES: **RESOURCES:**	**ASSESSMENTS:** **REMEDIATION:** **ENRICHMENT:**

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Integrated Science	**GRADE(S): 12**
UNIT 5: Electromagnetic Spectrum and Light	**TIMEFRAME: 8 weeks**

PA ACADEMIC STANDARDS

3.2.12.A - **Physical Sciences: Chemistry and Physics ~ Chemistry**

3.2.12.A.1.
- Compare and contrast colligative properties of mixtures. Compare and contrast the unique properties of water to other liquids.

3.2.12.A.2.
- Distinguish among the isotopic forms of elements. Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus. Explain how light is absorbed or emitted by electron orbital transitions.

3.2.12.A.3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation E=mc2.

3.2.12.A.4.
- Apply oxidation/reduction principles to electrochemical reactions. Describe the interactions between acids and bases.

3.2.12.A.5.
- MODELS/PATTERNS Use VSEPR theory to predict the molecular geometry of simple molecules. CONSTANCY AND CHANGE Predict the shift in equilibrium when a system is subjected to a stress.

3.2.12.B - **Physical Sciences: Chemistry and Physics ~ Physics**

3.2.12.B.1.
- Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.

3.2.12.B.2.
- Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.

3.2.12.B.3.
- Describe the relationship between the average kinetic molecular energy, temperature, and phase changes.

3.2.12.B.4.
- Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.

3.2.12.B.5.
- Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.

3.2.12.B.6.
- CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

KEY CONCEPTS:

Light is a *wave* of changing electric and magnetic fields. Light waves are caused by disturbances in an electromagnetic field, like the acceleration of charged particles (such as electrons). Light has a dual nature; at times, it acts like waves, while at other times it acts like particles, called *photons*. Light travels through space at the maximum speed allowed by the laws of physics, called the speed of light. Light has no mass, but it carries energy and momentum. Fermat's principle states that *light will always take the path that takes the least amount of time* (not distance).

OBJECTIVES / ESSENTIAL KNOWLEDGE:

1. Define electromagnetic waves and how they travel.
    - Light is energy that is emitted by accelerating electric charges- often in atoms. This energy travels in a wave that is partly electric and partly magnetic. This is called an electromagnetic wave.
    - Electromagnetic waves can travel through a vacuum, or empty space, as well as through matter
2. Describe the speed of electromagnetic waves
    - Light and all electromagnetic waves travel at the same speed when in a vacuum
    - The speed of light in a vacuum, c, is 3.00×10^8 meters per second
3. Describe how electromagnetic energy is transferred through space as electromagnetic waves of varying wavelength and frequency
    - Electromagnetic waves vary in wavelength and frequency
    - As the wavelength increases the frequency decreases
    - Waves transport energy with transporting matter
    - Electromagnetic waves are transverse waves that can travel through empty space
    - Electromagnetic waves contain electric and magnetic parts that vibrate up and down perpendicular to the direction the wave travels
4. Describe the different frequencies of electromagnetic waves
    - The electromagnetic spectrum includes radio waves, infrared rays, visible light, ultraviolet rays , and gamma rays
    - Radio waves are used in radio and television technologies as well as in microwave and radar. They have the longest wavelengths and the lowest frequencies in the electromagnetic spectrum
    - Infrared rays are used as a source of heat and to discover areas of heat differences. Infrared rays have higher frequencies than radio waves and lower frequencies than red light
    - Visible light enables people to see. The visible part of the electromagnetic spectrum is light that the human eye can see. Each wavelength in the visible spectrum corresponds to a specific frequency and has a particular color
    - Ultraviolet rays have applications in health, medicine and agriculture. The wavelengths of ultraviolet rays vary from 400 nanometers to about 4 nanometers. They have higher frequencies than violet light
    - Gamma Rays are used in the medical field to kill cancer cell and to make pictures of the brain. They have the shortest wavelengths in the electromagnetic spectrum and have the highest frequencies and therefore the most energy and the greatest penetrating ability of all electromagnetic waves
    - The frequency of a wave is the number of wavelengths that pass by a point each second.
5. List and describe the three types of materials that affect the behavior of light.
    - Materials can be transparent, translucent or opaque
    - Transparent materials transmits light which means that it allows most light to pass through
    - Translucent material scatters light and allows some light to pass through
    - Opaque materials absorb or reflects light that strikes it and does not allow any light to pass through
6. Explain how light behaves when it enters a new medium.
    - When light strikes a new medium, the can be reflected, absorbed or transmitted.
    - When light is transmitted, it can be refracted, polarized or scattered.
    - A light wave can refract or bend when it passes at an angle from one medium into another
    - Light with waves that vibrate in only one plane is polarized light
    - Scattering means that light is redirected as it passes through a medium
7. Explain how a prism separates white light and how the color of an object is determined.
    - As white light passes through a prism, shorter wavelengths refract more than longer wavelengths, and the colors separate
    - The color of any object depends on what the object is made of and on the color of light that strikes the object

8. List and describe the six common sources of light and how each light source generates light.
    - Incandescent-The light produced when and object gets hot enough to glow is incandescent. When electrons flow through the filament of an incandescent bulb, the filament gets hot and emits light
    - Fluorescent-Fluorescent light bulbs emit light by causing a phosphor to steadily emit photons
    - Laser light is emitted when excited atoms of a solid, liquid or gas emit photons
    - Neon lights emit light when electrons move through a gas or a mixtures of gases inside glass tubing
    - Tungsten-halogen light is produced similar to an incandescent light except that a tungsten-halogen bulb has a small amount of halogen gas
    - Sodium-vapor light contains a small amount of solid sodium as well as a mixture of neon and argon gases. As electric current passes through a sodium-vapor bulb, it ionizes the gas mixture.

ACTIVITIES: **RESOURCES:**	**ASSESSMENTS:** **REMEDIATION:** **ENRICHMENT:**

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Integrated Science	**GRADE(S): 12**
UNIT 6: Optics	**TIMEFRAME: 4 weeks**

PA ACADEMIC STANDARDS

3.2.12.A - **Physical Sciences: Chemistry and Physics ~ Chemistry**

3.2.12.A.1.
- Compare and contrast colligative properties of mixtures. Compare and contrast the unique properties of water to other liquids.

3.2.12.A.2.
- Distinguish among the isotopic forms of elements. Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus. Explain how light is absorbed or emitted by electron orbital transitions.

3.2.12.A.3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation E=mc2.

3.2.12.A.4.
- Apply oxidation/reduction principles to electrochemical reactions. Describe the interactions between acids and bases.

3.2.12.A.5.
- MODELS/PATTERNS Use VSEPR theory to predict the molecular geometry of simple molecules. CONSTANCY AND CHANGE Predict the shift in equilibrium when a system is subjected to a stress.

3.2.12.B - **Physical Sciences: Chemistry and Physics ~ Physics**

3.2.12.B.1.
- Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.

3.2.12.B.2.
- Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.

3.2.12.B.3.
- Describe the relationship between the average kinetic molecular energy, temperature, and phase changes.

3.2.12.B.4.
- Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.

3.2.12.B.5.
- Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.

3.2.12.B.6.
- CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

KEY CONCEPTS:

- The overall study of how light behaves is called optics.
- The branch of optics that focuses on the creation of images is called geometric optics, because it is based on relationships between angles and lines that describe light rays.

OBJECTIVES / ESSENTIAL KNOWLEDGE:

1. Describe the functions of convex and concave lenses, a prism, and a flat mirror.
    - Concave lenses always cause light rays to spread out and can only form virtual images. Concave mirrors are often used in car headlights and flashlights.
    - Convex lenses can form either real or virtual images.
    - A prism is a solid piece of glass with flat polished surfaces that can cause light to change directions.
    - A mirror with a flat surface is a flat or plane mirror. A plane mirror always produces a virtual image.
    - A virtual image is a copy of an object formed at the location from which the light rays appear to come.
2. Describe how light rays form an image.
    - Images appear in mirrors because of how light is reflected by mirrors.
    - The incident ray follows the light falling onto the mirror.
    - The reflected ray follows the light bouncing off the mirror.
3. Calculate the angles of reflection and refraction for a single light ray.
    - The law of reflection states that the angle of reflection is equal to the angle of incidence.
    - When a ray of light crosses from on material to another, the amount it bends depends on the difference in the index of refraction between the two materials.
    - Snell's law of refraction is the relationship between the angles of incidence and refraction and the index of refraction of both materials.
4. Describe commonly used optical instruments and how they used.
    - Telescope- is an instrument that uses lenses or mirrors to collect and focus light from distant objects. There are two main types of telescopes, reflecting telescopes and refracting telescopes. Reflecting telescopes use mirrors and convex lenses to collect and focus light while refracting telescopes use convex lenses to collect and focus light
    - Camera- Light rays enter a camera through an opening, are focused by the opening or lens, and form and image that is recorded.
    - Microscope-an optical instrument that uses lenses to provide enlarged images of very small, near objects. The compound microscope uses two convex lenses to magnify small objects.
5. Research the technology behind fiber optics and common applications.
    - Fiber-optic lines are strands of optically pure glass as thin as a human hair that carries digital information over long distances.
    - Single-mode fibers have small cores and transmit infrared laser light. Multi-mode fibers have larger cores and transmit infrared light (wavelength = 850 to 1,300 nm) from light-emitting diodes (LEDs).
    - The light in a fiber-optic cable travels through the core (hallway) by constantly bouncing from the cladding (mirror-lined walls), a principle called total internal reflection. Because the cladding does not absorb any light from the core, the light wave can travel great distances.
    - Fiber-optic communications is based on the principle that light in a glass medium can carry more information over longer distances than electrical signals can carry in a copper or coaxial medium or radio frequencies through a wireless medium.
    - The advantages provided by optical fiber systems are the result of a continuous stream of product innovations and process improvements.

ACTIVITIES: **RESOURCES:**	**ASSESSMENTS:** **REMEDIATION:** **ENRICHMENT:**

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Integrated Science	**GRADE(S): 12**
UNIT 7: Electricity	**TIMEFRAME: 3 weeks**

PA ACADEMIC STANDARDS

3.2.12.A - **Physical Sciences: Chemistry and Physics ~ Chemistry**

3.2.12.A.1.
- Compare and contrast colligative properties of mixtures. Compare and contrast the unique properties of water to other liquids.

3.2.12.A.2.
- Distinguish among the isotopic forms of elements. Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus. Explain how light is absorbed or emitted by electron orbital transitions.

3.2.12.A.3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation E=mc2.

3.2.12.A.4.
- Apply oxidation/reduction principles to electrochemical reactions. Describe the interactions between acids and bases.

3.2.12.A.5.
- MODELS/PATTERNS Use VSEPR theory to predict the molecular geometry of simple molecules. CONSTANCY AND CHANGE Predict the shift in equilibrium when a system is subjected to a stress.

3.2.12.B - **Physical Sciences: Chemistry and Physics ~ Physics**

3.2.12.B.1.
- Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.

3.2.12.B.2.
- Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.

3.2.12.B.3.
- Describe the relationship between the average kinetic molecular energy, temperature, and phase changes.

3.2.12.B.4.
- Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.

3.2.12.B.5.
- Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.

3.2.12.B.6.
- CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

KEY CONCEPTS:

Electricity can exist as static electricity or travel as a current through a conductor. Electrons have negative charge and protons have positive charge. In any process, electric charge is conserved. The total electric charge of the universe does not change. Therefore, electric charge can only be transferred – not lost – from one body to another. Normally, electric charge is transferred when electrons leave the outer orbits of the atoms of one body (leaving it positively charged) and move to the surface of another body (causing the new surface to gain a negative net charge). Similarly-charged objects have a repulsive force between them. Oppositely charged objects have an attractive force between them.

OBJECTIVES / ESSENTIAL KNOWLEDGE:

1. Explain how an electric charge is produced.
    - Electric charge is a property that causes protons and electrons to attract or repel each other
    - An excess or shortage of electrons produces a net electric charge
2. Describe an electric force.
    - The force of attraction or repulsion between electrically charged objects is electric force
    - Electric force depends on the charge and distance
    - Opposite charges attract each other
    - Like charges repel each other
3. Design an investigation to illustrate the effects of static electricity.
    - Static electricity is the study of the behavior of electric charges, including how charge is transferred between objects
    - Charge can be transferred by friction, by contact and by induction
    - Friction can cause electrons to be transferred from one object to another. These static electrical charges can build up on an object and be discharged slowly or rapidly. This is often called static electricity
4. Construct and compare series and parallel circuits.
    - An electric circuit is a complete path through which charge can flow
    - In a series circuit, charge has only one path through which it can flow. If one element stops functioning in a series circuit none of the elements can operate
    - A parallel circuit is an electric circuit with two or more path through which charges can flow. If one element stops functioning in a parallel circuit the rest of the element still can operate
5. Construct simple circuits to determine the relationship between voltage, resistance, and current.
    - Current:
        a. In an electric circuit, voltage, resistance and current are related. According Ohm's Law, this relationship can be written V=IR
        b. The continuous flow of electric charge is electric current
        c. There are two types of current- direct current and alternating current
        d. Charge flows in one direction in direct current (DC) (battery operated devices normally use direct current
        e. Alternating current (AC) is flow of electric charge that regularly reverses its direction (electric current in home and school is normally AC
    - Resistance
        a. Resistance is opposition to the flow of charges in a material. A material's thickness, length, and temperature affect its resistance
        b. Electric resistance is due to collisions between flowing electrons and the atoms in a material
        c. Electric resistance in a circuit converts electrical energy into thermal energy and light
    - Voltage
        a. Voltage is a measure of the amount of electrical potential energy an electron flowing in a circuit can gain
        b. As voltage increases more potential energy is available to be transformed into other forms of energy
        c. Voltage is measured in volts (V)
6. Determine the electric power used in a circuit.
    - The electric power used by an appliance is the rate at which the appliance converts electrical energy to other forms of energy
    - The electric power used by an appliance can be calculated using the equation P= IV (Power equals current x voltage)
    - The electrical energy used by an appliance depends on the power of the appliance and the length of time it is used. Electrical energy usually is measured in kWh.

ACTIVITIES: **RESOURCES:**	**ASSESSMENTS:** **REMEDIATION:** **ENRICHMENT:**

POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Integrated Science	**GRADE(S): 12**
UNIT 8: Magnetism	**TIMEFRAME: 3 weeks**

PA ACADEMIC STANDARDS

3.2.12.A - **Physical Sciences: Chemistry and Physics ~ Chemistry**

3.2.12.A.1.
- Compare and contrast colligative properties of mixtures. Compare and contrast the unique properties of water to other liquids.

3.2.12.A.2.
- Distinguish among the isotopic forms of elements. Explain the probabilistic nature of radioactive decay based on subatomic rearrangement in the atomic nucleus. Explain how light is absorbed or emitted by electron orbital transitions.

3.2.12.A.3.
- Explain how matter is transformed into energy in nuclear reactions according to the equation E=mc2.

3.2.12.A.4.
- Apply oxidation/reduction principles to electrochemical reactions. Describe the interactions between acids and bases.

3.2.12.A.5.
- MODELS/PATTERNS Use VSEPR theory to predict the molecular geometry of simple molecules. CONSTANCY AND CHANGE Predict the shift in equilibrium when a system is subjected to a stress.

3.2.12.B - **Physical Sciences: Chemistry and Physics ~ Physics**

3.2.12.B.1.
- Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.

3.2.12.B.2.
- Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.

3.2.12.B.3.
- Describe the relationship between the average kinetic molecular energy, temperature, and phase changes.

3.2.12.B.4.
- Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.

3.2.12.B.5.
- Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.

3.2.12.B.6.
- CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

KEY CONCEPTS:

The magnetic properties of ordinary materials are produced primarily by the spin of electrons in atoms. Spin is a Quantum mechanical property that for electrons can have only two values. A particle with spin has its own magnetic field.

OBJECTIVES / ESSENTIAL KNOWLEDGE:

1. Describe the behavior of magnets.
   - A magnet has a north pole and a south pole
   - Like magnetic poles repel each other; unlike poles attract each other

- A magnet is surrounded by a magnetic field that exerts forces on other magnets
- Some materials are magnetic because their atoms behave like magnets

2. Relate the behavior of magnets to magnetic fields.
    - Electricity is related to magnetism. Magnetic fields can produce electrical current in conductors. Electricity can produce a magnetic field and cause iron and steel objects to act like magnets.
    - A magnetic force is exerted through a magnetic field
    - A moving electric charge such a moving electron creates a magnetic field
    - Magnetic fields surround all magnets
    - Magnetic field lines begin at the magnet's North Pole and end on the South Pole. The field lines are close together where the field is strong and get further apart as the field gets weaker
    - Earth is surrounded by a magnetic field similar to the field around a bar magnet
    - Earth's magnetic poles move slowly, and sometimes change places. Earth's magnetic poles now are close to Earth's geographic poles
3. Explain why some materials are magnetic.
    - Only certain materials such as iron can be made into magnets that are surrounded by a magnetic field
4. Describe how the magnetic field of an electromagnet depends on the current and number of coils.
    - Electromagnets are temporary magnets that lose their magnetism when the electric current is removed.
    - An electromagnet is made by wrapping a current-carrying wire around an iron core
    - To produce electric current, the wire is fashioned into a loop and a power source provides the kinetic energy to spin the wire loop.
    - The magnetic field of an electromagnet is turned on or off when the electric current is turned on or off
5. Explain how motion can produce electricity.
    - In an electric motor, a magnetic field turns electricity into motion.
    - A generator uses a magnetic field to turn motion into electricity.
6. Describe how motors, generators and transformers function
    - An electric motor transforms electrical energy into kinetic energy. An electric motor rotates when current flows through the wire loop that is surrounded by a magnetic field
    - A generator is a device that converts mechanical energy into electrical energy. Most of the electrical energy we use comes from generators. Electric motors convert electrical energy into mechanical energy that is used to do work. Examples of motors include those in many household appliances, such as blenders and washing machines
    - A transformer changes the voltage of an alternating current
    - Both a motor and a generator have magnets (or electromagnets) and a coil of wire that creates another magnetic field.

ACTIVITIES: **RESOURCES:**	**ASSESSMENTS:** **REMEDIATION:** **ENRICHMENT:**