Honors Physical Science

Semester A Summary:

This is the first of two courses that comprise Honors Physical Science. Throughout the semester, the student will be introduced to a variety of basic concepts in the field of chemistry. The student will also be introduced to the forces and motion, including topics of Newton's laws and the conservation of momentum.

This course consists of varied curriculum that provides the student the opportunity to use a scientific approach to problem-solving and making real-world connections. The student will investigate how matter is classified, explore the structure of an atom, identify groups within the periodic table, compare and contrast chemical reactions, study the properties of acids and bases and identify how to apply forces and motion to objects.

Semester A Outline

1. **Course Overview**
    1. Course Overview
2. **Atomic Structure**
    1. Atomic Structure Introduction
    2. Composition of Atoms
        - In this section, you will utilize models and the periodic table to identify subatomic particles.
        - In this lesson, you will learn how atoms are constructed and will distinguish between neutral atoms, isotopes, and ions using a PhET® simulation.
    3. Molecules and Structures
        - In this section, you will analyze models to describe the atomic composition of molecules and structures formed by covalent, ionic, and metallic bonds.
    4. Periodic Table Introduction
        - In this section, you will describe patterns in the properties of similarly grouped elements by asking questions about locations of common elements on the periodic table.
        - In this section, you will examine historical experiments that led scientists to determine the structure of the atom and analyze the patterns in the periodic table.
        - In this lesson, you will explore Rutherford scattering in detail using a PhET® simulation.
    5. Atomic Number

- In this section, you will use information embedded in the structure of the periodic table to help you predict the relative properties of elements.

6. Stable Ions
    - In this section, you will discover more information embedded in the structure of the periodic table regarding each atom's protons, neutrons, and electrons.
7. Valence Electrons 1
    - In this section, you will describe electrons in the outermost energy level of atoms in the periodic table that are helpful in making predictions.
8. Reactivity
    - In this section, you will use the periodic table to predict the reactivity of atoms based on their outermost electrons.
9. Bonds: Including Carbon Compounds
    - In this section, you will use the periodic table to predict the number and types of chemical bonds that atoms of elements can form.
    - In this section, you will learn why carbon atoms are able to form many different compounds.
10. Ions
    - In this lesson, you will examine energy level diagrams and the periodic table to make predictions about the ions that are likely to form from specific atoms.
11. Atomic Structure Apply
12. Atomic Structure Review
13. Atomic Structure Unit Test

3. **Properties**
    1. Properties Introduction
    2. The Impact of Synthetic Materials
        - In this section, you will support a claim that the creation and use of human-made materials impact society in positive and negative ways. You will also learn about the physical properties of these materials and how they contribute to these effects.
    3. The Impact of Synthetic Materials Discussion
    4. Thermal Energy and Kinetic Molecular Theory
        - In this section, you will develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
        - In this section, you will describe phase transitions in terms of the kinetic molecular theory.
    5. Gases Under Pressure
        - In this section, you will describe the relationships among pressure, temperature, and volume of an enclosed gas when the amount of gas is constant.
        - In this lesson, you will explore pressure, volume, and temperature variables of the Ideal Gas law using a PhET® simulation.

- In this section, you will determine molar quantities using computational thinking based on the ideal gas law.

6. Solutes and Solvents
    - In this section, you will use models to explain how solutes dissolve in solvents.
    - In this section, you will explore how temperature and pressure affect the solubility of different solutes.
    - In this lesson, you will explore concentration of solutes in solvents using a PhET® simulation.
7. Ph, Acids, and Bases
    - In this section, you will use the concept of pH as a model to predict the relative properties of strong, weak, concentrated, and dilute acids and bases.
    - In this section, you will comment on the strengths of two acids or two bases with similar composition.
    - In this lesson, you will explore the pH scale using a PhET® simulation to make adjustments to the pH of a solution.
8. Acid Base Solutions
    - In this lesson, you will explore acids and bases using a PhET® simulation to identify strong and weak acids and bases.
    - In this lesson, you will explore acid strength using a PhET® simulation.
    - In this lesson, you will explore base strength using a PhET® simulation.
9. Properties Apply
10. Properties Review
11. Properties Unit Test

4. **Chemical Reactions**
    1. Chemical Reactions Introduction
    2. Physical vs. Chemical Change
        - In this section, you will distinguish between chemical and physical change.
    3. Chemical Reactions
        - In this section, you will describe and apply the Law of Conservation of Mass to chemical reactions and balance chemical equations.
        - In this section, you will describe and apply the law of conservation of mass to chemical reactions and balance chemical equations.
    4. Patterns of Properties
        - In this section, you will use knowledge of the periodic table, patterns of chemical properties, and understanding of electron energy levels to better understand chemical reactions.
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        - In this section, you will use knowledge of the periodic table, patterns of chemical properties, and understanding of electron energy levels to better understand chemical reactions.
    5. Balance of Atoms

- In this section, you will explain the fact that the total number of atoms of each element is the same in the reactants and the products of a chemical reaction.
- In this lesson, you will explore chemical reactions using a PhET® simulations. You will manipulate products, reactants, and leftovers in a number of chemical reactions.

6. Conservation
    - In this section, you will explain and apply the law of conservation of mass during chemical reactions.
    - In this section, you will describe how the total number of atoms and the mass of reactants and products does not change during a chemical reaction.
7. Covalent and Ionic Bonding
    - In this section, you will use valence electron states and electronegativity to explain a simple chemical reaction, including the numbers and types of bonds that each atom forms.
8. Types of Reactions
    - In this section, you will describe the characteristics of redox, acid-base, synthesis, and single- and double-replacement chemical reactions.
    - In this section, you will use models to predict the products of chemical reactions.
    - In this section, you will describe oxidation-reduction reactions in living and nonliving systems.
9. Reaction Rates Portfolio 1
    - In this section, you will use evidence to explain the effects of changing the temperature or concentration of chemical reaction rates, including the idea that as the kinetic energy of colliding particles increases and the number of collisions increases, the reaction rate increases.
10. Reaction Rates Portfolio 2
    - In this section, you will evaluate evidence to explain how increasing the concentration of reactants causes an increase in the rate of a chemical reaction.
    - In this section, you will evaluate evidence to explain how increasing the temperature of reactants causes an increase in the rate of a chemical reaction.
11. Reaction Rates Portfolio 3
    - In this section, you will describe how changing the concentration or temperature of reactants affects the rate of a chemical reaction.
12. Total Bond Energy
    - In this section, you will develop a model to illustrate that the release or absorption of energy from a chemical reaction depends upon the changes in total bond energy.
13. Changes in Bond Energy
    - In this section, you will describe the changes in bond energies during reactions.

14. Chemical Reactions Apply
15. Chemical Reactions Review
16. Chemical Reactions Unit Test

5. **Nuclear Processes**
    1. Nuclear Processes Introduction
    2. Energy Release
        - In this section, you will describe parts of a model that shows the composition of the nucleus of the atom.
    3. Modeling Nuclear Processes
        - In this section, you will develop models that show the relationships between components that underlie several nuclear processes.
    4. Modeling Fusion and Fission
        - In this section, you will develop a model that shows a process called nuclear fusion in which two nuclei merge to form a single, larger nucleus.
        - In this section, you will develop a model that shows a process called nuclear fission in which a nucleus splits into two or more parts.
    5. Radioactive Decay Energy
        - In this section, you will develop models of radioactive decay that show the differences in the types of energy and/or particles released.
    6. Alpha Particle Emission
        - In this section, you will develop a radioactive decay model that classifies alpha decay as a type of nuclear fission and beta and gamma decays as not nuclear fission.
    7. Nuclear Processes Apply
    8. Nuclear Processes Review
    9. Nuclear Processes Unit Test
6. **Newton's Laws**
    1. Newton's Laws Introduction
    2. Newton's First Law
        - In this section, you will explain Newton's First Law of Motion supported by real-life examples as evidence.
    3. Newton's Second Law
        - In this section, you will explain Newton's Second Law of Motion supported by real-life examples as evidence.
        - In this section, you will analyze data that represent the net force on a macroscopic object, its mass (which is held constant), and its acceleration.
        - In this lesson, you will explore the net force in detail using a PhET® simulation titled Force and Motion Basics: Net Force or the alternative activity.
    4. Force, Mass, and Acceleration
        - In this section, you will analyze data related to Newton's second law of motion by using tools, technologies, and/or models.
        - In this lesson, you will explore the relationship between net force, mass, and acceleration in detail using a PhET® simulation titled Force and Motion

Basics: Acceleration, which can be accessed by clicking here and selecting Acceleration.

5. Newton's Third Law
    - In this section, you will explain how Newton’s Third Law applies to problems involving the motion of two colliding objects.
    - In this section, you will explain how Newton’s Third Law applies to problems involving the motion of two colliding objects.
6. Collision Forces
    - In this section, you will select an example of a real-life collision. You will design a solution that considers equal and opposite forces in order to calculate how much force is exerted by the first object on the second, and by the second object on the first, during the collision.
7. Newton's Laws Apply
8. Newton's Laws Review
9. Newton's Laws Unit Test

7. **Force and Motion**
    1. Force and Motion Introduction
    2. Position, Distance, and Displacement
        - In this section, you will distinguish between various terms that describe how an object’s position changes and how fast its position and direction change.
        - In this section, you will describe the motion of an object by graphically showing the relationship between time and position.
    3. Vectors
        - In this section, you will learn about the difference between vector and scalar quantities and how to use them.
        - In this section, you will plan and carry out an investigation that uses mathematical and graphical models to analyze the motion of an object.
    4. Magnitude and Direction of Force
        - In this section, you will explain that forces have both a magnitude and direction; forces affect the motion of objects.
    5. Forces that Change Motion
        - In this section, you will analyze the forces that change an object’s motion by calculating force, net force, and momentum.
    6. Velocity and Acceleration
        - In this section, you will use data as evidence to describe that the relationship between the observed quantities is accurately modeled across the range of data by the formula a=Fnet/m, for example, double force yields double acceleration.
        - In this section, you will examine how net force affects an object’s motion by examining velocity vs. time graphs.
        - In this section, you will learn how to use equations of motion to solve problems involving constant velocity and constant acceleration.
        - In this section, you will learn to analyze motion by understanding the relationship between position, velocity, and acceleration.

7. Correlation and Causation
    - In this section, you will distinguish between causal and correlational relationships linking force, mass, and acceleration. You will use the data as empirical evidence to tell the difference between these relationships.
8. Net Force and Acceleration
    - In this section, you will explain the relationship $F_{net}=ma$ in terms of a net force on an object causing the object to accelerate.
9. Force and Motion Concepts
    - In this section, you will learn about dynamic equilibrium in terms of a net force acting upon a moving object with constant velocity.
    - In this section, you will learn that the speed of light is the fastest speed in the universe and that it is measured as the same speed regardless of the motion of any observers.
10. Force and Motion Apply
11. Force and Motion Review
12. Force and Motion Unit Test

8. **Conservation of Momentum**
    1. Conservation of Momentum Introduction
    2. Momentum
        - In this section, you will calculate the momentum of each object in a system as the product of its mass and its velocity, $p=mv$.
        - In this section, you will evaluate how the total momentum of a system of two interacting objects is constant if there is no net force on the system.
    3. The Moment of Impact
        - In this section, you will describe the physical interaction of the two objects in terms of the change in the momentum of each object as a result of the interaction.
    4. Using Vectors to Describe Momentum
        - In this section, you will describe the total momentum of the system by calculating the vector sum of momenta of the two objects in the system.
    5. Zero Net Force
        - In this section, you will analyze the motion of the objects before the interaction to identify a system with essentially no net force on it.
    6. Proving Conservation of Momentum
        - In this section, you will support a claim, based on an analysis of the total momentum of the system, that the momentum of the system is the same before and after the interaction between the objects in the system so that momentum of the system is constant.
    7. Momentum Portfolio Day 1
        - In this portfolio, you will minimize the force of a collision on an object by designing a container that mimics the exoskeleton of cockroaches and other hard-to-squash insects.
        - In this section, you will design a device that minimizes the force on an object during a collision. The device must incorporate the concept that for a given change in momentum, force in the direction of the change in momentum is decreased by increasing the time interval of the collision. Your device must also reduce the net force applied to the object by extending the time the force is applied to the object during the collision.

- In this section, you will describe the scientific rationale for choice of materials in a design plan for a device that minimizes the force on a macroscopic object during a collision, and for the structure of the device.

8. Momentum Portfolio Day 2
    - In this section, you will describe the criteria and constraints, along with the tradeoffs in design solutions that minimize a force on an object during a collision, such as in seatbelts or football helmets.
    - In this section, you will test and evaluate a device based on its ability to minimize the force on the test object during a collision.
    - In this section, you will identify any unanticipated effects or design performance issues exhibited on a device that minimizes the force on a macroscopic object during a collision.
9. Momentum Portfolio Day 3
    - In this section, you will improve the performance of a device that minimizes the force on a macroscopic object during a collision. You will use test results to extend the impact time, reduce the device mass, and/or consider cost-benefit analysis.
10. Conservation of Momentum Apply
    - In this section, you will explain why a baseball that is rolling eventually stops and what happens to its kinetic energy.
11. Conservation of Momentum Review
12. Conservation of Momentum Unit Test

9. Physical Science A Semester Review and Exam

1. Physical Science A Semester Review
2. Physical Science A Semester Exam

Semester B Summary:

This is the second of two courses that comprise Honors Physical Science. Throughout the semester, the student will study a variety of essential physics concepts including energy of motion, energy and forces, thermal energy, non-contact forces, waves, and electromagnetic radiation. This course includes a variety of instructional strategies and provides the student the opportunity to use a scientific approach to problem-solving and making real-world connections. Honors Physical Science B includes hands-on explorations and virtual simulations to enhance the student's comprehension of key concepts.

Semester B Outline

1. **Course Overview**
    1. Course Overview
2. **Force and Work**
    1. Force and Work Introduction
    2. Force and Work Relationships
        - In this section, you will scientifically describe the relationship between force and work.
    3. Pulleys and Incline Planes
        - In this section, you will describe pulleys and inclined planes, analyze their effect on work and energy, and calculate their mechanical advantage, including specialized inclined planes such as the screw.

- In this section, you will develop an understanding of the relationship in pulleys and inclined planes between distance, displacement, force, work, and energy visually, through diagrams, and quantitatively, through equation manipulation.

4. Levers
    - In this section, you will understand diagrammatically and quantitatively levers and the three classes thereof.
    - In this section, you will understand levers' effects on force, distance, and work using data tables.
    - In this section, you will understand the relationship between the classes of levers, force, work, and energy.
5. Efficiency of Machines
    - In this section, you will qualitatively and quantitatively evaluate the efficiency of machines, and identify common forms of energy that affect efficiency.
    - In this section, you will quantitatively evaluate the efficiency of simple machines in reducing the effort or the amount of energy transferred to the surrounding environment.
    - In this section, you will describe methods for testing solutions that improve the efficiency of a machine by reducing the effort or the amount of energy transferred to the surrounding environment as it moves an object.
6. Force and Work Apply
7. Force and Work Review
8. Force and Work Unit Test

3. **Gravity**
    1. Gravity Unit Introduction
    2. Gravitational Force, Attraction, and Mass
        - In this section, you will define and describe gravitational force and explain the relationship between mass and acceleration when calculating gravitational force on objects on Earth and the Moon.
        - In this section, you will analyze data to calculate gravitational force on different planets using the formula for force.
    3. Investigating Gravity
        - In this section, you will plan an investigation to determine the effect of gravity on objects of different masses.
        - In this section, you will plan an investigation to determine the effect of gravity on objects of different masses.
    4. Analyzing Gravitational Data
        - In this section, you will analyze data from an investigation to provide evidence that the acceleration of objects near Earth's surface is the same regardless of the mass of those objects.
        - In this section, you will analyze data from an investigation to provide evidence that the acceleration due to gravity of objects near Earth is the same, regardless of the mass of those objects.
    5. Gravity and Air Resistance

- In this section, you will explain the relationship between air resistance and gravity on a falling object, and calculate an object's terminal velocity.

6. Gravity Apply
7. Gravity Review
8. Gravity Unit Test

4. **Energy of Motion**
    1. Energy of Motion Unit Introduction
    2. Kinetic and Potential Energy
        - In this section, you will describe the relationship between the energy an object possesses when it is in motion and its stored energy that comes from its position relative to Earth.
        - In this section, you will describe the relationship between the energy an object possesses when it is in motion and its stored energy because of its position relative to Earth.
    3. Factors that Affect Kinetic Energy
        - In this section, you will record how the mass and the speed of an object affect the amount of kinetic energy it possesses, and you will calculate a moving object's kinetic energy.
        - In this section, you will record how changing the mass and the speed of an object affect the energy it possesses because it is in motion.
    4. Predicting Changes in Kinetic Energy
        - In this section, you will predict how changing the mass or speed of an object will change the energy the object possesses because it is in motion. Potential Energy of a System.
    5. Potential Energy of a System
        - In this section, you will design a visual or 3-D model to represent how the positioning of multiple objects in a system can influence the system's stored energy.
    6. Energy Transfer and Kinetic Energy
        - In this section, you will construct an explanation, by using a real-life example, of how energy transfer can be shown through changes in energy that an object possesses because of its motion.
    7. Using Potential and Kinetic Energy
        - In this section, you will analyze how humans use technology to store energy resulting from an object's position relative to Earth and/or use energy resulting from an object's motion.
    8. Conservation of Mechanical Energy
        - In this section, you will create a model of the transformation of mechanical energy in simple systems and those with periodic motion and on which only conservative forces act.
        - In this section, you will use mathematical thinking to calculate whether mechanical energy is being conserved in a given system ($KE=½mv^2$,$PEg=mgh$,$PEe=½kx^2$)
    9. Energy of Motion Apply

10. Energy of Motion Review
11. Energy of Motion Unit Test

5. **Energy and Forces**
    1. Energy and Forces Introduction
    2. Two Object Interaction
        - In this section, you will explain the nature of the interaction and the relative magnitude and direction of the net force on when two objects interact.
        - In this section, you will describe the relationships between parts of a model of two objects interacting through electric or magnetic fields to show the forces and changes in energy involved when two objects interact.
    3. Stored Energy Changes I
        - In this section, you will determine whether the energy stored in the field increased, decreased, or remained the same when the objects interacted.
    4. Stored Energy Changes II
        - In this section, you will defend a claim that the change in the energy stored in the field is consistent with the change in energy of the objects.
    5. Cause and Effect
        - In this section, you will describe the cause and effect relationships on a qualitative level between forces produced by electric or magnetic fields and the change of energy of the objects in the system.
    6. Energy and Forces Motion Portfolio 1
        - For this portfolio activity, you will design, construct, and test a device that converts one form of energy into another form, and then evaluate the device's performance.
        - In this section, you will design a device that converts one form of energy into another form of energy.
    7. Energy and Forces Motion Portfolio 2
        - In this section, you will design an experiment to test how the strength of an electromagnet can be increased or decreased.
        - In this section, you will build and test an electromagnet according to a design plan.
    8. Energy and Forces Motion Portfolio 3
        - In this section, you will systematically and quantitatively evaluate the performance of your electromagnet, pulling together what you have learned about electricity and magnetism in order to understand their intertwined relationship.
    9. Energy of Four Forces
        - In this section, you will compare the magnitude and range of the four fundamental forces.
    10. Energy and Forces Apply
        - In this section, you will determine how a practical application of electric and magnetic fields depends on charged or magnetic objects or particles and which role is played by electric or magnetic fields.
    11. Energy and Forces Review

12. Energy and Forces Unit Test

6. **Thermal Energy**
    1. Thermal Energy Unit Introduction
    2. Kinetic and Thermal Energy
        - By the end of this lesson, you will be able to explain the relationship between kinetic (movement) energy and thermal energy.
    3. Matter and Temperature
        - In this section, you will identify and describe properties of matter in relation to energy resulting from motion and heat energy as measured by temperature
    4. Energy Transfer and Temperature
        - In this section, you will identify and describe the effect of thermal energy on a substance's atoms and molecules, and how that relates to temperature, as well as the ability or inability of a substance to transmit thermal energy.
        - In this section, you will analyze data collected about how the transfer of energy resulting from motion affects the matter in relation to the temperature of a sample of the matter.
        - In this section, you will learn how teams of scientists work together toward a common goal.
    5. Kinetic Energy Transfer
        - In this section, you will analyze data from an investigation about how thermal energy affects the molecules of a substance.
        - In this section, you will explain data from an investigation about how the energy that results from motion affects matter in relation to the temperature of the sample.
        - In this section, you will develop conclusions from an investigation about how thermal energy affects the molecules of a substance.
    6. Thermal Energy Transfer Device Portfolio 1
        - In this portfolio activity, you will apply scientific principles to design, construct, and test a device that maximizes thermal energy transfer.
        - In this section, you will develop questions and discuss in groups about how to maximize or minimize heat energy transfer.
        - In this section, you will learn about and evaluate concepts related to the design of a device that will maximize thermal energy transfer.
        - In this section, you will plan your design, define the standards by which you judge your devices success, and identify the restrictive factors that must be taken into account in the design solution.
    7. Thermal Energy Transfer Device Portfolio 2
        - In this section, you will review and relate the processes you will be utilizing when you design a device to maximize heat energy transfer.
        - In this section, you will test a device to minimize or maximize heat energy transfer.
        - In this section, you will evaluate the effectiveness of and, ultimately, improve upon a device to maximize thermal energy transfer by using test data.

8. Thermal Energy Transfer Device Portfolio 3
    - In this section, you will modify and retest the device you created.
    - In this section, you will reflect on the design of the device to maximize heat energy transfer and apply information you have learned in this process.
9. Thermal Energy Transfer
    - In this section, you will use a model to explain how thermal energy is transferred out of hotter regions or objects and into colder ones by convection.
    - In this section, you will use a model to explain how thermal energy is transferred out of hotter regions or objects and into colder ones by conduction and radiation.
10. Thermal Energy Apply
11. Thermal Energy Review
12. Thermal Energy Unit Test

7. **Non-Contact Forces**
    1. Non-Contact Forces Introduction
    2. Strength of Electrical Forces
        - In this section, you will explore electric forces, and the dependencies on this force based upon distances from the individual charges that generate the forces, and the magnitude of the charges.
    3. Conductors and Insulators
        - In this section, you will describe the position and movement of electrons through electrical conductors and insulators.
    4. Electrical Energy Properties
        - In this section, you will analyze data to describe the properties of electrical energy and become familiar with the equations used to find current, resistance, and voltage when two of the three are known.
    5. Electrical Circuits
        - In this section, you will explain how energy is conserved as it is transferred and transformed in electrical circuits from batteries and dissipated in components such as light bulbs.
        - In this section, you will explain the functions of wires, a battery, a light bulb, and a switch in the transfer of power through a circuit.
        - In this lesson, you will explore circuits in detail using a PhET® simulation titled Circuit Construction Kit: DC or the alternative assignment. Both can be accessed below.
    6. Strength of Magnetic Forces
        - In this section, learn about how magnetic fields are formed, and you will analyze data to determine the factors that affect the strength of magnetic forces.
    7. Non-Contact Forces Portfolio 1
        - In this section, you will use a demonstration to collect observations and generate questions about electromagnetic induction.

- In this section, you will collect observations and generate questions about the strength of electric fields from a demonstration.
- In this section, you will collect observations and generate questions about the strength of magnetic fields.

8. Non-Contact Forces Portfolio 2
   - In this section, you will design an investigation to explore fields that exist between two objects that are not in contact.
   - In this section, you will perform multiple trials of an investigation to collect data about fields between two non-touching objects.
   - In this section, you will analyze data and draw conclusions about how fields that exist between two objects that are not in contact.
9. Non-Contact Forces Portfolio 3
   - In this section, you will evaluate an experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
10. Electromagnetism in Use
    - In this section, you will explain how electric currents and magnetic fields are related to each other through the use of the technology called the magnetically levitated train, the maglev.
11. Non-Contact Forces Apply
12. Non-Contact Forces Review
13. Non-Contact Forces Unit Test

8. **Waves**
   1. Waves Introduction
   2. Lens and Mirrors
      - In this section, you will learn to use specific equations to locate the images formed by lenses and mirrors.
      - In this section, you will identify and describe refraction, reflection, diffraction, absorption, and superposition of light waves.
   3. Wave Characteristics
      - In this section, you will compare mechanical and electromagnetic waves in terms of wave characteristics and behavior.
      - In this lesson, you will explore waves in detail using a PhET® simulation titled Waves or the alternative assignment. Both can be accessed below.
   4. Sound Wave Phenomena
      - In this section, you will explain what happens to the observed frequency of a sound wave when the relative positions of an observer and wave source changes, such as in the Doppler effect.
      - In this section, you will communicate scientific and technical information about how the principle of superposition explains the resonance and harmonic phenomena in air columns and on strings and common sound devices.
   5. Beat Frequency

- In this section, you will describe the phenomena of resonance frequencies and beat frequencies that arise from the interference of sound waves of slightly different frequencies.
- In this section, you will define the beat frequency as the difference between the frequencies of two individual sound wave sources.

6. Characteristics of Waves
    - In this section, you will describe relevant components in mathematical representations.
7. Frequency and Wavelength
    - In this section, you will identify and/or describe relevant components in the mathematical representations of waves. Your description will include the relationships between frequency, wavelength, and speed of waves traveling in various specified media.
8. The Speed of Sound
    - In this section, you will demonstrate how the wave speed for a wave changes as the medium through which the wave travels changes.
9. Waves in Different Media
    - In this section, you will predict the relative change in the wavelength of a wave when it moves from one medium to another. You will explain the different wave speeds using the mathematical relationship $v = f\lambda$.
10. Wavelength in Different Media
    - In this section, you will express the relative change in wavelength in terms of cause (different media) and effect (different wavelengths but same frequency)
11. Wave Application
    - In this section, you will use the mathematical relationship $v = \lambda f$ to assess claims about any of the three quantities when the other two quantities are known for waves traveling in various specified media.
12. Digital and Analog Systems
    - In this lesson, you will evaluate questions to determine if their answers illustrate the features associated with digital transmission and storage of information. This may include information that can be stored reliably without degradation over time, transferred easily, and copied and shared rapidly.
13. Life Without Digital Systems
    - In this lesson, you will discuss how answers to questions about digital systems relate to real-life examples, such as emailing your homework to a teacher, copying music, using the internet for research, and social media.
14. Life Without Digital Systems Discussion
15. Pros and Cons of Digital Systems
    - In this lesson, you will evaluate questions about digital systems and determine whether given features are advantages or disadvantages.
16. Waves Apply

- In this section, you will apply what you know about how wavelength, frequency, and wave speed are connected to study how animals use sound to communicate.

17. Waves Review
18. Waves Unit Test

9. Semester Review and Exam

1. Physical Science B Semester Review
2. Physical Science B Semester Exam

