Physics
Overview
2024-2025

This document is designed to provide parents/guardians/community an overview of the curriculum taught in the FBISD classroom. This document supports families in understanding the learning goals for the course, and how students will demonstrate what they know and are able to do. The overview offers suggestions or possibilities to reinforce learning at home.

Included at the end of this document, you will find:

- A glossary of curriculum components
- The content area instructional model
- Parent resources for this content area

To advance to a particular grading period, click on a link below.

The process standards describe ways in which students are expected to engage in the content. The Scientific and Engineering Practices (SEPs) describe practices that students need to do in the classroom in order to learn the content. The Recurring Themes and Concepts (RTCs) describe how students need to think about the content in order to learn it.

Scientific and Engineering Practices

PHY.1A ask questions and define problems based on observations or information from text, phenomena, models, or investigations.
PHY.1B use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems.
PHY.1C use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency approved safety standards.
PHY.1D use appropriate tools such as balances, ballistic carts or equivalent, batteries, computers, constant velocity cars, convex lenses, copper wire, discharge tubes with power supply (H, He, Ne, Ar), data acquisition probes and software, dynamics and force demonstration equipment, electrostatic generators, electrostatic kits, friction blocks, graph paper, graphing technology, hand-held visual spectroscopes, inclined planes, iron filings, lab masses, laser pointers, magnets, magnetic compasses, metric rulers, motion detectors, multimeters (current, voltage, resistance), optics bench, optics kit, photogates, plane mirrors, prisms, protractors, pulleys, resistors, rope or string, scientific calculators, stopwatches, springs, spring scales, switches, tuning forks, wave generators, or other equipment and materials that will produce the same results.
PHY.1E collect quantitative data using the International System of Units (SI) and qualitative data as evidence.
PHY.1F organize quantitative and qualitative data using bar charts, line graphs, scatter plots, data tables, labeled diagrams, and conceptual mathematical relationships.
PHY.1G develop and use models to represent phenomena, systems, processes, or solutions to engineering problems.
PHY.1H distinguish among scientific hypotheses, theories, and laws.
PHY.2A identify advantages and limitations of models such as their size, scale, properties, and materials.
PHY.2B analyze data by identifying significant statistical features, patterns, sources of error, and limitations.

PHY.2C use mathematical calculations to assess quantitative relationships in data.
PHY.2D evaluate experimental and engineering designs.
PHY.3A develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories.
PHY.3B communicate explanations and solutions individually and collaboratively in a variety of settings and formats.
PHY.3C engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.
PHY.4A analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student.
PHY.4B relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content.
PHY.4C research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers.

Grading Period 1

Unit 1: Motion

Estimated Date Range: August 8 – September 16
Estimated Time Frame: 27 days

Unit Overview:
In this unit, students will explore the fundamental principles of motion and forces. They will begin by analyzing different types of motion through hands-on activities and real-time technology such as motion detectors and digital applications, creating and interpreting graphs of position vs. time, velocity vs. time, and acceleration vs. time. Students will then delve into one-dimensional motion, applying equations to understand concepts such as distance, displacement, speed, velocity, frames of reference, and acceleration. They will practice solving problems involving these variables to deepen their comprehension of motion in a single direction.
Next, students will explore scalar and vector quantities in both one and two-dimensional motion. They will define these quantities and practice combining vectors using graphical vector addition and the Pythagorean theorem. Lastly, students will analyze acceleration in uniform circular motion and horizontal projectile motion in two dimensions, using equations to describe and calculate acceleration in these scenarios.

At home connections:

- Use a smartphone or camera to record the motion of objects around your home. Analyze the videos frame by frame to estimate position changes over time. Create hand-drawn position vs. time graphs based on your observations.
- Explore motion detector apps available on smartphones or computer simulations that allow you to generate real-time position, velocity, and acceleration data. Compare and contrast hand-drawn graphs with those generated by the digital tools.
- Measure distances and time intervals during activities like walking or jogging. Calculate your average speed and then determine your velocity in different directions based on your path (displacement).
- Investigate how frames of reference affect your perception of motion. Compare the motion of objects from different reference points (e.g., inside a moving vehicle vs. standing on the ground). Use equations to describe the motion relative to each frame of reference.
- Identify and list examples of scalar and vector quantities around your home (e.g., temperature vs. velocity of a moving car). Discuss with family members or peers why each quantity is classified as scalar or vector.
- Use a ruler and protractor to draw arrows representing different vectors on paper. Practice adding these vectors graphically using the tip-to-tail method and verify your results using the Pythagorean theorem.

• Explore projectile motion by launching objects (e.g., paper airplanes or small balls) horizontally and at an angle. Use equations to predict and calculate the acceleration of these projectiles, considering gravity and air resistance where applicable. • Research and simulate uniform circular motion using a string and an object (e.g., a ball) to swing in a circle. Measure and analyze the acceleration of the object using equations that describe circular motion.	
Concepts within Unit # 1 **Link to High School Science TEKS**	**Success Criteria for this concept** *Students will…*
Concept #1: Safety	• identify and use the correct safety equipment, such as goggles and gloves during laboratory activities. • follow safety procedures and guidelines as outlined in the Texas Education Agency approved safety standards. • demonstrate safe handling and disposal of chemicals and other materials in the lab. • recognize and respond appropriately to safety hazards in the classroom, laboratory, and field settings. • explain the importance of safety practices and how they prevent accidents and injuries.
Concept #2: Analyzing Motion 5A, 5B, 5C	• record the motion of objects using a smartphone or camera and analyze the videos frame by frame to estimate changes in position over time. • create hand-drawn position vs. time graphs based on my observations of recorded motion. • use motion detector apps or simulations to generate real-time position, velocity, and acceleration data. • identify examples of scalar and vector quantities at school and explain why each is classified as scalar or vector. • distinguish between scalar quantities (magnitude only) and vector quantities (magnitude and direction). • draw arrows representing vectors on paper using a ruler and protractor. • add vectors graphically using the tip-to-tail method. • measure distances and time intervals during activities like walking or jogging. • calculate my average speed based on measured distances and time intervals. • determine velocity of objects in different directions by considering displacement over time. • investigate and explain how different frames of reference affect my perception of motion. • use equations to describe motion relative to different frames of reference, such as comparing motion inside a moving vehicle with motion observed from a stationary point.
Concept #3: Projectile Motion 5D	• explore projectile motion by launching objects horizontally and at an angle. • predict and calculate the acceleration of projectiles using equations • compare the accelerations observed in different types of motion and explain the differences
Concept #4: Circular Motion 5D	• simulate uniform circular motion using simple materials like string and an object (e.g., a ball). • measure and analyze the acceleration of an object in uniform circular motion using equations that describe circular motion
Unit 2: Forces Estimated Date Range: September 17 – October 9 Estimated Time Frame: 15 days	

Unit Overview:
In this unit, students will explore the principles of forces and motion through the lens of Newton's laws of motion and the concepts of impulse and momentum. They will start by calculating the effects of various forces on objects using free body diagrams and Newton's second law of motion. Students will then delve into the concepts of equilibrium and inertia as described by Newton's first law of motion, applying these ideas to real-world scenarios such as rockets, satellites, and automobile safety devices. By understanding these foundational principles, students will be equipped to illustrate and analyze the forces between two objects using free body diagrams and experimental designs, as per Newton's third law of motion.
Additionally, students will learn to calculate and describe the impulse and momentum of objects in various physical systems, including automobile safety features, athletics, and rockets. They will analyze the conservation of momentum qualitatively in both inelastic and elastic collisions in one dimension, using models, diagrams, and simulations to visualize these concepts. Through hands-on activities, problem-solving exercises, and real-world applications, students will develop a comprehensive understanding of how forces and motion govern the physical world around them.

At home connections:

- Create a free body diagram for a simple scenario at home, such as a book resting on a table. Identify and label the forces acting on the book, including gravity, normal force, and any applied forces if you push or pull the book. Use Newton's second law of motion to calculate the net force and the resulting acceleration if the book is moved.
- Demonstrate inertia using a household object like a toy car or a cup. Place the object on a flat surface and observe how it remains at rest until an external force is applied. Discuss how this relates to Newton's first law of motion, using real-world examples like the behavior of passengers in a car during sudden stops.
- Use two objects, such as two balls or two books, and push them against each other. Create free body diagrams for both objects, illustrating Newton's third law of motion by showing the action and reaction forces. Discuss how these forces are equal in magnitude and opposite in direction.
- Use a rubber ball and measure its mass and velocity before and after it hits a wall. Calculate the ball's momentum before and after the collision and use the change in momentum to determine the impulse. Discuss how this activity relates to real-world systems like car safety features.
- Set up a simple collision experiment using marbles or small balls. Roll one ball into another and observe the collision. Use a video recording to analyze the velocities before and after the collision. Discuss whether the collision is elastic or inelastic and how the total momentum is conserved in the system.

Concepts within Unit #2 **Link to High School Science TEKS**	**Success Criteria for this concept** *Students will…*
Concept #1: Newton's Laws of Motion	• create a free body diagram for a simple scenario, such as a book resting on a table, and identify the forces acting on it. • use Newton's second law of motion to calculate the net force and resulting acceleration when forces are applied to an object. • demonstrate inertia using objects and explain how this concept relates to Newton's first law of motion. • provide real-world examples of equilibrium and inertia. • create free body diagrams for two objects in contact, showing the action and reaction forces as described by Newton's third law of motion. • explain how the forces between two objects are equal in magnitude and opposite in direction.

Grading Period 2

Unit 2: Forces (continued)

Estimated Date Range: September 17 – October 9
Estimated Time Frame: 9 days

Unit Overview:
In this unit, students will explore the principles of forces and motion through the lens of Newton's laws of motion and the concepts of impulse and momentum. They will start by calculating the effects of various forces on objects using free body diagrams and Newton's second law of motion. Students will then delve into the concepts of equilibrium and inertia as described by Newton's first law of motion, applying these ideas to real-world scenarios such as rockets, satellites, and automobile safety devices. By understanding these foundational principles, students will be equipped to illustrate and analyze the forces between two objects using free body diagrams and experimental designs, as per Newton's third law of motion.
Additionally, students will learn to calculate and describe the impulse and momentum of objects in various physical systems, including automobile safety features, athletics, and rockets. They will analyze the conservation of momentum qualitatively in both inelastic and elastic collisions in one dimension, using models, diagrams, and simulations to visualize these concepts. Through hands-on activities, problem-solving exercises, and real-world applications, students will develop a comprehensive understanding of how forces and motion govern the physical world around them.

At home connections:

- Create a free body diagram for a simple scenario at home, such as a book resting on a table. Identify and label the forces acting on the book, including gravity, normal force, and any applied forces if you push or pull the book. Use Newton's second law of motion to calculate the net force and the resulting acceleration if the book is moved.
- Demonstrate inertia using a household object like a toy car or a cup. Place the object on a flat surface and observe how it remains at rest until an external force is applied. Discuss how this relates to Newton's first law of motion, using real-world examples like the behavior of passengers in a car during sudden stops.
- Use two objects, such as two balls or two books, and push them against each other. Create free body diagrams for both objects, illustrating Newton's third law of motion by showing the action and reaction forces. Discuss how these forces are equal in magnitude and opposite in direction.
- Use a rubber ball and measure its mass and velocity before and after it hits a wall. Calculate the ball's momentum before and after the collision and use the change in momentum to determine the impulse. Discuss how this activity relates to real-world systems like car safety features.
- Set up a simple collision experiment using marbles or small balls. Roll one ball into another and observe the collision. Use a video recording to analyze the velocities before and after the collision. Discuss whether the collision is elastic or inelastic and how the total momentum is conserved in the system.

Concepts within Unit # 2 Link to High School Science TEKS	**Success Criteria for this concept** *Students will…*
Concept #1: Newton's Laws of Motion 5E, 5F, 5G	• create a free body diagram for a simple scenario, such as a book resting on a table, and identify the forces acting on it. • use Newton's second law of motion to calculate the net force and resulting acceleration when forces are applied to an object. • demonstrate inertia using objects and explain how this concept relates to Newton's first law of motion. • provide real-world examples of equilibrium and inertia. • create free body diagrams for two objects in contact, showing the action and reaction forces as described by Newton's third law of motion. • explain how the forces between two objects are equal in magnitude and opposite in direction.

Concept #2: Collisions 7D, 7E	• measure the mass and velocity of a moving object before and after a collision to calculate its momentum. • determine the impulse from the change in momentum and relate this to real-world systems like car safety features. • set up and observe a simple collision experiment, recording the velocities of objects before and after the collision. • analyze whether a collision is elastic or inelastic and explain how the total momentum is conserved in the system.

Unit 3: Energy

Estimated Date Range: October 29 – December 10

Estimated Time Frame: 24 days

Unit Overview:

In this unit, students will explore the concepts of work, power, and energy, focusing on their calculations and real-world applications. They will begin by learning to calculate and explain work and power in one dimension, identifying situations where work is and is not being done on a system. Students will conduct experiments and solve problems to understand the conditions under which work is performed and how power quantifies the rate of doing work. They will also investigate and calculate the mechanical, kinetic, and potential energy of various systems, analyzing how these different forms of energy are quantified and interrelated.

Building on this foundation, students will apply the concept of conservation of energy using the work-energy theorem, energy diagrams, and energy transformation equations. They will explore how energy transforms between kinetic, potential, and thermal forms in different scenarios, and how these transformations illustrate the principle of energy conservation. Through hands-on activities, problem-solving exercises, and real-world examples, students will develop a comprehensive understanding of how work, energy, and power are fundamental to the functioning of physical systems.

At home connections:

- Measure the distance and force applied when moving a heavy object (like a chair or a book) across the floor. Calculate the work done using the formula Work = Force × Distance. Then, time how long it takes to move the object and calculate the power using the formula Power = Work/Time. Discuss when work is being done and when it is not (e.g., holding the object stationary vs. moving it).
- Use a simple pendulum made from a string and a small weight. Measure the height of the pendulum at its highest point and calculate its potential energy using Potential Energy = mgh (mass x gravity x height). Then, release the pendulum and observe its motion, discussing how the potential energy converts to kinetic energy as it swings.
- Set up a small ramp and roll a toy car down it. Measure the car's speed at various points along the ramp. Create an energy diagram showing how the car's potential energy at the top of the ramp converts to kinetic energy as it moves down, and how some energy might transform into thermal energy due to friction. Discuss the conservation of energy using your observations and measurements.

Concepts within Unit # 3 Link to High School Science TEKS	**Success Criteria for this concept** *Students will…*
Concept #1: Classifying Energy and Work 7A, 7B	• measure the force applied and the distance over which an object is moved. • calculate the work done using the formula Work = Force × Distance. • explain when work is and is not being done on a system by analyzing different scenarios.
Concept #2: Mechanical Energy 7B	• Use a simple pendulum and measure its height to calculate potential energy. • calculate the potential energy of an object using the formula Potential Energy=mgh (mass x gravity x height). • observe and describe how potential energy converts to kinetic energy in a moving pendulum.

	• calculate the kinetic energy of a moving object and explain the energy transformations.
Concept #3: Conservation of Energy 7C	• design an investigation to determine the speed of a toy car at various points along the ramp. • create an energy diagram showing the transformation of potential energy to kinetic energy and thermal energy. • explain the conservation of energy using my observations and measurements from the ramp experiment. • describe how energy is conserved in a system, even when it changes forms.

Grading Period 3

Unit 4: Newton's Law of Universal Gravitation

Estimated Date Range: January 9 – January 22
Estimated Time Frame: 9 days

Unit Overview:
In this unit, students will explore the fundamental principles of forces and gravitation, focusing on Newton's law of universal gravitation and its applications. They will begin by learning to describe and calculate the gravitational force between two objects, using scientific notation to handle large and small values effectively. Students will understand how the magnitude of the gravitational force depends on the masses of the objects and the distance between their centers and will predict the effects of these forces on objects in linear and orbiting systems (PHY.5H). They will apply these concepts to real-world scenarios, such as planetary orbits and satellite motion, to deepen their understanding of gravitational interactions.
Students will also investigate the effects of various forces, including tension, friction, normal, gravity, centripetal, and applied forces, on objects using free body diagrams and Newton's second law of motion (PHY.5F). They will calculate how these forces influence acceleration and motion, solving problems that involve different force scenarios. Through hands-on activities, simulations, and problem-solving exercises, students will develop a comprehensive understanding of how forces and gravitation govern the motion and interaction of objects, preparing them for more advanced studies in physics.

At home connections:

- Research the masses and distances between various objects in your home, such as between two books on a shelf or a small object on the table and the Earth. Use Newton's law of universal gravitation to calculate the gravitational force between these objects. Discuss how the force changes with different distances and masses and relate this to real-world examples like the gravitational attraction between the Earth and the Moon.
- Create a simple experiment using household items to observe different forces. For example, use a rubber band to apply tension to a small object, and measure the object's acceleration. Create a free body diagram to represent all the forces acting on the object (e.g., tension, friction, normal force, gravity). Use Newton's second law of motion to calculate the net force and predict the object's acceleration based on your measurements and observations.

Concepts within Unit # 4 Link to High School Science TEKS	**Success Criteria for this concept** *Students will…*
Concept #1: Universal Gravitation 5H	• identify the masses of various objects and the distances between them. • use Newton's law of universal gravitation to calculate the gravitational force between two objects, using scientific notation to handle large or small values effectively. • explain how the gravitational force changes with different masses and distances. • predict the effects of gravitational forces on objects in linear and orbiting systems, relating these predictions to real-world examples such as planetary orbits.
Concept #2: Orbital Motion 5H, 5F	• Use mathematical models, including equations and vector diagrams, to describe and predict the motion of orbiting objects in the solar system. • Define tidal forces and explain how they affect Earth, the moon, and other celestial bodies.
Concept #3: Kepler's Laws 5H, 5F	• Use Kepler's laws to describe the motions of orbiting objects, including their elliptical paths around the sun. • Use the relationship between orbital period and orbital radius to predict the motions of orbiting planets in the solar system.

Unit 5: Electricity and Magnetism

Estimated Date Range: January 23 – February 24
Estimated Time Frame: 21 days

Unit Overview:
In this unit, students will delve into the principles of electric forces and fields, starting with Coulomb's law to understand how the magnitude of the electric force between two objects depends on their charges and the distance between their centers. Using scientific notation, students will predict and calculate these forces, applying their knowledge to real-world scenarios (PHY.6A). They will also explore everyday examples of electric and magnetic forces and fields, such as those found in generators, motors, and transformers (PHY.6B). This will help them identify and describe the roles of electric forces and fields in various technologies and daily life applications.
Students will investigate the conservation of charge through processes such as induction, conduction, and polarization using materials like electroscopes, balloons, rods, fur, silk, and Van de Graaf generators (PHY.6C). Additionally, they will analyze, design, and construct series and parallel circuits using schematic diagrams and materials such as switches, wires, resistors, lightbulbs, batteries, voltmeters, and ammeters (PHY.6D). By applying Ohm's law, they will calculate the current, potential difference, resistance, and power in these circuits (PHY.6E). Through hands-on experiments, problem-solving activities, and theoretical analysis, students will develop a comprehensive understanding of electric forces, fields, and circuits.

At home connections:

- Research the charges and distances between everyday objects around your home, such as balloons rubbed on hair or different materials. Use Coulomb's law and scientific notation to predict and calculate the electric force between these objects. Discuss how the magnitude of the force changes with different charges and distances and relate your findings to practical scenarios like static electricity or the operation of electronic devices.
- Explore your home and identify examples of electric and magnetic forces and fields in everyday devices like generators, motors, or transformers. Describe how each device uses these forces and fields to function, such as how a motor converts electrical energy into mechanical motion or how transformers regulate voltage in electrical systems. Discuss the practical applications and importance of these devices in daily life.
- Conduct experiments using materials like balloons, rods, fur, silk, or a Van de Graaff generator to investigate the conservation of charge through induction, conduction, and polarization. Use an electroscope or other simple tools to observe how charges transfer or redistribute when different materials interact. Describe and document your findings, explaining how conservation of charge applies in each scenario.
- Design and construct simple series and parallel circuits using switches, wires, resistors, lightbulbs, batteries, voltmeters, and ammeters. Follow schematic diagrams to build the circuits and analyze how the arrangement affects current flow, potential difference, resistance, and power consumption. Measure and record your observations using the instruments provided and discuss how series and parallel configurations impact circuit behavior.
- Calculate various parameters in electric circuits using Ohm's law. For example, measure the current through different parts of a circuit, calculate the potential difference across components, determine the resistance using voltage and current measurements, and compute the power consumed by various elements. Document your calculations and compare the results between series and parallel circuit configurations, discussing the practical implications of your findings.

Concepts within Unit # 5 Link to High School Science TEKS	**Success Criteria for this concept** *Students will…*
Concept #1: Electric Force 6A, 6B, 6C	• use scientific notation to represent charges and distances in Coulomb's law calculations. • predict the magnitude of the electric force between two objects based on their charges and the distance between their centers using Coulomb's law. • explain how changes in charges or distances affect the electric force between objects. • identify generators, motors, and transformers as devices that utilize electric forces to function. • describe how electric forces play a crucial role in the operation of generators by inducing electric currents through electromagnetic induction.

	• explain how electric forces contribute to the operation of motors. • demonstrate conservation of charge through experiments involving induction, conduction, and polarization using materials like electroscopes, balloons, rods, fur, silk, and Van de Graaff generators. • describe how charges redistribute or transfer during these processes and explain the principles of conservation of charge. • predict and explain the behavior of charges in different materials based on their electrical properties.
Concept #2: Circuits 6B, 6D, 6E	• analyze and differentiate between series and parallel circuits using schematic diagrams. • design and construct series and parallel circuits using appropriate materials such as switches, wires, resistors, lightbulbs, batteries, voltmeters, and ammeters. • calculate and predict current, potential difference, resistance, and power in series and parallel circuits using Ohm's law and relevant formulas. • calculate the current through various parts of a circuit using Ohm's law and measured values of voltage and resistance. • determine the potential difference across circuit components using voltage measurements and Ohm's law. • calculate the resistance of circuit elements using measured values of current and voltage. • compute the power used by electric circuit elements in both series and parallel configurations using appropriate formulas derived from Ohm's law.
Concept #3: Magnetic Forces 6B	• identify examples of electric forces and fields in everyday devices such as generators, motors, and transformers. • describe how electric forces and fields are utilized in these devices to perform work or transform energy. • identify examples of magnetic forces and fields in everyday devices like electric motors and transformers and explain their role in the device's operation.

Unit 6: Waves

Estimated Date Range: February 25 – March 7
Estimated Time Frame: 8 days

Unit Overview:
In this unit, students will explore the fundamental characteristics and behaviors of waves. They will investigate wave properties such as velocity, frequency, amplitude, and wavelength, and develop an understanding of the relationships between wave speed, frequency, and wavelength through hands-on activities and calculations. Applying these concepts to real-world examples will reinforce their understanding of wave dynamics.

Next, students will examine simple harmonic motion in masses on springs and pendulums, as well as wave energy propagation in various media like surface waves on water and pulses in ropes. They will explore how energy travels through these systems, linking theoretical principles with practical observations. Additionally, they will compare transverse and longitudinal waves, including electromagnetic and sound waves, distinguishing between these types based on particle oscillation direction relative to wave propagation and using everyday examples for reinforcement.

Lastly, students will investigate wave behaviors such as reflection, refraction, diffraction, interference, standing waves, the Doppler effect, polarization, and superposition. Through experiments and simulations, students will observe and analyze these phenomena, gaining insights into how waves interact with different materials and environments. This comprehensive study will equip students with foundational knowledge to tackle advanced physics concepts and apply their understanding to practical scientific and technological challenges.

At home connections:
- Create a simple pendulum using a string and a weight. Measure its period and explore how changing the length of the string affects its oscillation. Relate this to wave energy propagation in different media.
- Listen to different musical instruments and identify whether they produce sound waves that are transverse or longitudinal. Discuss the direction of particle oscillation and how it relates to the nature of the wave.
- Use a mirror and a flashlight to explore how light reflects off different surfaces. Observe the angle of incidence and angle of reflection and discuss the law of reflection.
- Fill a glass with water and place a pencil partially submerged in the water. Observe how the pencil appears to bend at the water's surface due to refraction. Discuss how the speed and direction of light change when moving from one medium to another.
- Shine a flashlight through a narrow slit or around the edge of an object. Observe the spreading of light waves beyond the edges of the slit or object, demonstrating diffraction. Discuss how wave behavior changes when encountering obstacles.
- Create interference patterns using two sources of water waves or light waves. Adjust the phase and observe constructive and destructive interference patterns. Discuss how interference occurs when waves overlap.
- Attach a string to fixed points and create standing waves by adjusting the frequency of vibration. Identify nodes (points of no displacement) and antinodes (points of maximum displacement) along the string. Discuss how standing waves are formed and their applications in musical instruments.
- Observe the Doppler effect with sound waves by standing near a roadway and listening to passing cars. Note how the pitch of the car's horn changes as it approaches and moves away from you. Discuss applications of the Doppler effect in astronomy and everyday technology.
- Use polarized sunglasses or polarizing filters to observe how light waves are selectively filtered based on their orientation. Rotate the filter and observe changes in light intensity. Discuss how polarization is used in reducing glare and in technologies like LCD screens.
- Use two ropes or springs to demonstrate superposition by creating overlapping waves with different frequencies or amplitudes. Observe how the resulting wave is a combination of the individual waves. Discuss how superposition applies to wave interactions and wave phenomena.

Concepts within Unit # 6 Link to High School Science TEKS	**Success Criteria for this concept** *Students will…*

Concept #1: Properties of Waves 8A, 8B, 8C	• describe the characteristics of simple harmonic motion and identify examples in everyday life. • use masses on springs and pendulums to observe and describe simple harmonic motion. • analyze the motion of a mass on a spring or a pendulum, calculating the period, frequency, and amplitude. • explain the energy transformations that occur in simple harmonic motion. • describe how energy propagates in various types of media. • analyze the behavior of surface waves on a body of water, identifying crests, troughs, and wave patterns. • create and observe pulses in ropes, explaining how energy is transmitted through the medium. • describe the characteristics of transverse waves. • identify and explain examples of transverse waves. • demonstrate transverse waves using physical models and relate them to real-world examples. • describe the characteristics of longitudinal waves. • identify and explain examples of longitudinal waves. • demonstrate longitudinal waves using physical models and relate them to real-world examples. • compare the properties of transverse and longitudinal waves. • explain how both types of waves transfer energy through different media. • analyze the behavior of transverse and longitudinal waves based on wavelength, frequency, and amplitude.

Grading Period 4

Unit 6: Waves (continued)

Estimated Date Range: March 17 – April 22
Estimated Time Frame: 24 days

Unit Overview:
In this unit, students will explore the fundamental characteristics and behaviors of waves. They will investigate wave properties such as velocity, frequency, amplitude, and wavelength, and develop an understanding of the relationships between wave speed, frequency, and wavelength through hands-on activities and calculations. Applying these concepts to real-world examples will reinforce their understanding of wave dynamics.

Next, students will examine simple harmonic motion in masses on springs and pendulums, as well as wave energy propagation in various media like surface waves on water and pulses in ropes. They will explore how energy travels through these systems, linking theoretical principles with practical observations. Additionally, they will compare transverse and longitudinal waves, including electromagnetic and sound waves, distinguishing between these types based on particle oscillation direction relative to wave propagation and using everyday examples for reinforcement.

Lastly, students will investigate wave behaviors such as reflection, refraction, diffraction, interference, standing waves, the Doppler effect, polarization, and superposition. Through experiments and simulations, students will observe and analyze these phenomena, gaining insights into how waves interact with different materials and environments. This comprehensive study will equip students with foundational knowledge to tackle advanced physics concepts and apply their understanding to practical scientific and technological challenges.

At home connections:

- Create a simple pendulum using a string and a weight. Measure its period and explore how changing the length of the string affects its oscillation. Relate this to wave energy propagation in different media.
- Listen to different musical instruments and identify whether they produce sound waves that are transverse or longitudinal. Discuss the direction of particle oscillation and how it relates to the nature of the wave.
- Use a mirror and a flashlight to explore how light reflects off different surfaces. Observe the angle of incidence and angle of reflection and discuss the law of reflection.
- Fill a glass with water and place a pencil partially submerged in the water. Observe how the pencil appears to bend at the water's surface due to refraction. Discuss how the speed and direction of light change when moving from one medium to another.
- Shine a flashlight through a narrow slit or around the edge of an object. Observe the spreading of light waves beyond the edges of the slit or object, demonstrating diffraction. Discuss how wave behavior changes when encountering obstacles.
- Create interference patterns using two sources of water waves or light waves. Adjust the phase and observe constructive and destructive interference patterns. Discuss how interference occurs when waves overlap.
- Attach a string to fixed points and create standing waves by adjusting the frequency of vibration. Identify nodes (points of no displacement) and antinodes (points of maximum displacement) along the string. Discuss how standing waves are formed and their applications in musical instruments.
- Observe the Doppler effect with sound waves by standing near a roadway and listening to passing cars. Note how the pitch of the car's horn changes as it approaches and moves away from you. Discuss applications of the Doppler effect in astronomy and everyday technology.
- Use polarized sunglasses or polarizing filters to observe how light waves are selectively filtered based on their orientation. Rotate the filter and observe changes in light intensity. Discuss how polarization is used in reducing glare and in technologies like LCD screens.

Use two ropes or springs to demonstrate superposition by creating overlapping waves with different frequencies or amplitudes. Observe how the resulting wave

Concepts within Unit # 6	Success Criteria for this concept

Link to High School Science TEKS	*Students will…*
Concept #1: Properties of Waves 8A, 8B	• describe the characteristics of simple harmonic motion and identify examples in everyday life. • use masses on springs and pendulums to observe and describe simple harmonic motion. • analyze the motion of a mass on a spring or a pendulum, calculating the period, frequency, and amplitude. • explain the energy transformations that occur in simple harmonic motion. • describe how energy propagates in various types of media. • analyze the behavior of surface waves on a body of water, identifying crests, troughs, and wave patterns. • create and observe pulses in ropes, explaining how energy is transmitted through the medium. • describe the characteristics of transverse waves. • identify and explain examples of transverse waves. • demonstrate transverse waves using physical models and relate them to real-world examples. • describe the characteristics of longitudinal waves. • identify and explain examples of longitudinal waves. • demonstrate longitudinal waves using physical models and relate them to real-world examples. • compare the properties of transverse and longitudinal waves. • explain how both types of waves transfer energy through different media. • analyze the behavior of transverse and longitudinal waves based on wavelength, frequency, and amplitude.
Concept #2: Wave Behavior and Sound 8A, 8B, 8D	• explain the law of reflection and apply it to predict the behavior of waves when they encounter a reflective surface. • Determine the angles of incidence and reflection. • describe how waves change speed and direction when passing from one medium to another. • calculate the refractive index of different materials. • explain how waves spread out when they pass through narrow openings or around obstacles. • demonstrate diffraction patterns using sound water waves and analyze the results. • describe superposition and how it leads to constructive and destructive interference. • create and analyze interference patterns using sound waves. • explain the formation of standing waves. • analyze the patterns of standing waves in strings or air columns. • describe the Doppler effect and provide real-world examples of the Doppler effect. • explain how polarization restricts the vibrations of waves to a particular direction. • demonstrate polarization using polarizing filters and explain its applications in everyday life. • describe how superposition applies to the combination of waves. • explain the effects of superposition.

Concept #3: Wave Optics and Light 8D, 8G	• Communicate cause-and-effect relationships related to light diffraction, reflection, and refraction. • Develop models to represent conditions that cause the diffraction, reflection, or refraction of different wave types. • Use data to show that wave speed changes as the medium through which a wave travels changes.

Unit 7: Electromagnetic Radiation

Estimated Date Range: April 23 – May 16
Estimated Time Frame: 18 days

Unit Overview:
In this unit, students will delve into the fascinating world of wave and quantum physics. They will start by investigating Malus's Law and the concept of wave polarization, examining how polarized light is used in everyday applications such as 3-D movie glasses and LCD computer screens. Students will also explore the various parts of the electromagnetic spectrum and their practical applications, comparing the uses of radio telescopes, microwaves, and x-rays. These investigations will provide a comprehensive understanding of how wave behaviors and properties impact technology and science.
The unit will then shift focus to quantum phenomena, beginning with an exploration of the photoelectric effect and atomic emission spectra, both explained by the photon model for light. Students will also learn about the wave-particle duality of light and how superposition of quantum states relates to this duality. Finally, students will study real-world applications of quantum physics, including the Heisenberg uncertainty principle, quantum computing, and cybersecurity.

At home connections:
- Use polarized sunglasses to observe how the intensity of light changes when looking at an LCD screen from different angles.
- Research and compare how different household devices (e.g., microwave oven, radio) use various parts of the electromagnetic spectrum for their functionality.
- Use a compact disc and a flashlight to observe the diffraction of light and create a simple spectroscope to view the emission spectra of different light sources.
- Watch an educational video or documentary on the double-slit experiment to understand the wave-particle duality of light and discuss its implications.
- Explore how quantum encryption is used in cybersecurity by reading a relevant article or watching a video on quantum computing and its impact on data security.

Concepts within Unit # 7 Link to High School Science TEKS	**Success Criteria for this concept** *Students will…*
Concept #1: EM Wave Properties and Applications 9B, 8B, 8D, 8E	• explain Malus's Law how it relates to the intensity of polarized light. • describe how wave polarization is used in 3-D movie glasses to create the illusion of depth. • explain how LCD computer screens use polarized light to display images and control brightness.
Concept #2: Quantum Phenomena 9A, 9C, 9D	• explain the photoelectric effect and how it provides evidence for the particle nature of light. • describe how emission spectra are produced by various atoms and use the photon model of light to explain these observations. • describe superposition in quantum mechanics and how it relates to the behavior of particles. • explain the wave-particle duality of light. • explain the basic principles of quantum computing and how it differs from classical computing.

	• describe how quantum phenomena are used in cybersecurity to improve data encryption and protection.
Concept #3: Radiation and Matter 9A, 8E, 8F	• identify the emission spectra of different elements using a spectroscope. • explain how the emission spectra correspond to specific wavelengths of light within the electromagnetic spectrum. • describe the process by which electrons emit light at specific wavelengths when they transition between energy levels in an atom.

Glossary of Curriculum Components

Overview– The content in this document provides an overview of the pacing and concepts covered in a subject for the year.

TEKS – Texas Essential Knowledge and Skills (TEKS) are the state standards for what students should know and be able to do.

Unit Overview – The unit overview provides a brief description of the concepts covered in each unit.

Concept – A subtopic of the main topic of the unit.

Success Criteria—a description of what it looks like to be successful in this concept.

Parent Resources

The following resources provide parents with ideas to support students' understanding. For sites that are password protected, your child will receive login information through their campus.

Resource	How it supports parent and students
Texas Experience Physics	This is the state adopted textbook for Physics. Students sign in through their school account in Clever.
Khan Academy	This resource contains practice exercises, instructional videos, and a personalized learning dashboard where students can learn and study at their own pace.
Texas Gateways	This online resource contains lessons, videos, and interactive activities for various science concepts.
NSTA – Science Resources for Parents	This online resource has science activities for high school students and their families to help support learning at home.

Supplemental Resource and Tool designation

TI-Nspire Calculator	This calculator is a standardized technology integration tool used for Science and Mathematics in FBISD.

Instructional Model

An instructional model is the structure in which students engage in a particular content that ensures understanding of that content. In science, the instructional model is the 5E Instructional Model.

The 5E Model is an inquiry-based approach to teaching and learning science concepts over time. It is research-based and emphasizes that children build conceptual understanding and make meaning through experiences. Each "E" represents a stage in a learning cycle.

- Engage: Students interact with a phenomenon that sparks curiosity and assesses prerequisite knowledge or misconceptions.
- Explore: Students begin to interact with the content through hands-on investigations.
- Explain: Students connect the hands-on experience to the instruction of the concept using grade level appropriate academic vocabulary.
- Elaborate: Students apply the concept learned to a new context through problem solving or an additional hands-on experience.
- Evaluate: Evaluation of student understanding and progress occurs throughout the learning cycle.

As students learn each concept in the curriculum, they will have the opportunity to develop conceptual understanding as the teacher navigate the content as telling a story. The graphic below summarizes each component that occurs within each of the 5E stages.