COPPELL ISD SCIENCE YEAR AT A GLANCE

AP PHYSICS

GRADE 10-12	11 UNITS

Program Transfer Goals

- Ask questions, recognize and define problems, and propose solutions.
- Safely and ethically collect, analyze, and evaluate appropriate data.
- Utilize, create, and analyze models to understand the world.
- Make valid claims and informed decisions based on scientific evidence.
- Effectively communicate scientific reasoning to a target audience.

PACING

First Nine Weeks	Second Nine Weeks	Third Nine Weeks	Fourth Nine Weeks

Unit 1 2 Weeks	Unit 2 3 Weeks	Unit 3 4 Weeks	Unit 4 4 Weeks	Unit 5 3 Weeks	Unit 6 3 Weeks	Unit 7 2 Weels	Unit 8 2 Weels	Unit 9 3 Weeks	Unit 10 3 Weels	Unit 11 3 Weeks

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Assurances for a Guaranteed and Viable Curriculum

Adherence to this scope and sequence affords every member of the learning community clarity on the knowledge and skills on which each learner should demonstrate proficiency. In order to deliver a guaranteed and viable curriculum, our team commits to and ensures the following understandings:

Shared Accountability: Responding to the Needs of All Learners

- High levels of learning for all students.
- The district and course formative assessments aligned to the standards for this course support educators and learners in monitoring academic achievement and leveraging interventions.

Shared Understanding: Curriculum Design

- The district curriculum design weaves together the elements of content, skills and assessments in order to adhere to curriculum design at the macro and micro level, ensuring vertical alignment.
- The district curriculum incorporates standards, scope and sequence, enduring understandings, essential questions, performance assessments, and recommended resources.

Interdependence: Curriculum Units

Members of the learning community utilize the curriculum units, plan collaboratively, and reflect on results for continuous improvement.
The district curriculum units may be found: http://tinyurl.com/Coppell-Curriculum

UNIT 1: FOUNDATIONS OF PHYSICS

TIMELINE: 2 WEEKS

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Students will know…

- Scientific notation uses only significant digits in a measured quantity.
- Only the last (least significant) digit can be written with uncertainty in its value.
- Estimation and proportional reasoning are powerful methods for analysis of problems.

Students will be skilled at…

- explaining a problem conceptually (showing the importance of unit cancellation)
- using proportional reasoning to analyze a problem conceptually
- renormalizing data to define linear relationships
- choosing appropriate variables to test (vary in value) and to control (keep fixed) in order to test an hypothesis
- deciding the criteria for acceptance/rejection of an hypothesis
- resolving and decomposing vectors

UNIT 2: KINEMATICS

TIMELINE: 3 WEEKS

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Students will know…

- Predicting motion requires two pairs of paired position-time data.
- Predicting acceleration requires defining instantaneous velocities.
- Instantaneous velocities are defined at the midpoint of two pairs of paired position-time data by finding the ratio of the difference in position divided by the difference in times and ASSIGNING that average velocity to the midpoint time.
- The difference in two midpoint velocities divided by the difference in midpoint times defines the average acceleration for the interval defined by the two midpoint times.
- Standard algebraic tools are restricted to one-dimensional problems.
- 2-d problems required decomposition into two 1-d problems that can be recombined only by applying trigonometric identities and the Pythagorean theorem.

Students will be skilled at…

- being able to express the motion of an object using narrative, mathematical, and graphical representations
- being able to design an experimental investigation of the motion of an object
- being able to analyze experimental data describing the motion of an object and is able to express the results of the analysis using narrative, mathematical, and graphical representations

Unit 3: Dynamics (Newton's Laws)

Timeline: 4 Weeks

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- Make valid claims and informed decisions based on scientific evidence.
- Effectively communicate scientific reasoning to a target audience.

Students will know…

- Intertial mass is the property of an object or system that determines how its motion changes when it interacts with the other objects or systems.
- Objects and systems have properties of inertial mass and gravitational mass that are experimentally verified to be the same and that satisfy conservation principles.
- Fores are described by vectors.
- Free-body diagrams are useful tools for visualizing forces being exerted on a single object and writing the equations that represent a physical situation.
- Contact forces result from the interaction of one object touching another object and they arise from inter-atomic electric forces. These forces include tension, friction, normal, spring.
- The linear motion of a system can be described by the displacement, velocity, and acceleration of its center of mass.

Students will be skilled at…

- designing an experiment for collecting data to determine the relationship between the net force exerted on an object its inertial mass and its acceleration
- designing a plan for collecting data to measure gravitational mass and to measure inertial mass and to distinguish between the two experiments
- representing forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation
- analysing a scenario and make claims (develop arguments, justify assertions) about the forces exerted on an object by other objects for different types of forces or components of forces
- creating and using free-body diagrams to analyze physical situations to solve problems with motion qualitatively and quantitatively

Unit 4: Work, Energy, and Conservation

Timeline: 4 weeks

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- Safely and ethically collect, analyze, and evaluate appropriate data.
- Utilize, create, and analyze models to understand the world.
- Make valid claims and informed decisions based on scientific evidence.
- Effectively communicate scientific reasoning to a target audience.

Students will know…

- A force exerted on an object can change the kinetic energy of the object.
- Interactions with other objects or systems can change the total energy of a system.
- Certain quantities are conserved, in the sense that the changes of those quantities in a given system are always equal to the transfer of that quantity to or from the system by all possible interactions with other systems.
- The energy of a system is conserved.
- The linear momentum of a system is conserved.

Students will be skilled at…

- the application of mathematical routines to determine the change in kinetic energy of an object given the forces on the object and the displacement of the object
- the application of the concepts of Conservation of Energy and the Work-Energy theorem to determine qualitatively and/or quantitatively that work done on a two-object system in linear motion will change the kinetic energy of the center of mass of the system, the potential energy of the systems, and/or the internal energy of the system
- defining open and closed systems for everyday situations and apply conservation concepts for energy, charge, and linear momentum to those situations
- calculating changes in kinetic energy and potential energy of a system, using information from representations of that system
- designing an experimental test of an application of the principle of the conservation of linear momentum, predict an outcome of the experiment using the principle, analyze data generated by that experiment whose uncertainties are expressed numerically, and evaluate the match between the prediction and the outcome

Unit 5: Impulse, Momentum, and Conservation of Linear Momentum

Timeline: 3 weeks

Transfer Goals:

- Ask questions, recognize and define problems, and propose solutions.
- Safely and ethically collect, analyze, and evaluate appropriate data.
- Utilize, create, and analyze models to understand the world.
- Make valid claims and informed decisions based on scientific evidence.
- Effectively communicate scientific reasoning to a target audience.

Students will know…

- A force exerted on an object can change the momentum of the object.

- Interactions with other objects or systems can change the total linear momentum of a system.
- Certain quantities are conserved, in the sense that the changes of those quantities in a given system are always equal to the transfer of that quantity to or from the system by all possible interactions with other systems.
- The linear momentum of a system is conserved.

Students will be skilled at…

- justifying the selection of data needed to determine the relationship between the direction of the force acting on an object and the change in momentum caused by that force
- designing a plan for collecting data to investigate the relationship between changes in momentum and the average force exerted on an object over time
- analyzing data to find the change in linear momentum for a constant-mass system
- designing an experimental test of an application of the principle of the conservation of linear momentum, predict an outcome of the experiment using the principle, analyze data generated by that experiment whose uncertainties are expressed numerically, and evaluate the match between the prediction and the outcome

UNIT 6: Rotational Motion: Torque, Rotational Kinematics and Energy, Rotational Dynamics and Conservation of Angular Momentum

TIMELINE: 3 WEEKS

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- Safely and ethically collect, analyze, and evaluate appropriate data.
- Utilize, create, and analyze models to understand the world.
- Make valid claims and informed decisions based on scientific evidence.
- Effectively communicate scientific reasoning to a target audience.

Students will know…

- A force exerted on an object can cause a torque on that object.
- The acceleration of the center of mass of a system is related to the net force exerted on the system, where a=Fm.
- A net torque exerted on a system by other objects or systems will change the angular momentum of the system.
- The angular momentum of a system is conserved.

Students will be skilled at…

- calculating torques on a two-dimensional system in static equilibrium, by examining a representation or model
- planning data collection and analysis strategies designed to test the relationship between a torque exerted on an object and the change in angular velocity of that object about an axis
- using representations of the center of mass of an isolated two-object system to analyze the motion of the system qualitatively and semiquantitatively
- describe or calculate the angular momentum and rotational inertia of a system in terms of the locations and velocities of objects that make up the system

Unit 7: Circular Motion and Universal Law of Gravitation

Timeline: 2 weeks

Transfer Goals:

- Ask questions, recognize and define problems, and propose solutions.
- Safely and ethically collect, analyze, and evaluate appropriate data.
- Utilize, create, and analyze models to understand the world.
- Make valid claims and informed decisions based on scientific evidence.
- Effectively communicate scientific reasoning to a target audience.

Students will know…

- Objects and systems have properties of inertial mass and gravitational mass that are experimentally verified to be the same and that satisfy conservation principles.
- A gravitational field is caused by an object with mass.
- All forces share certain common characteristics when considered by observers in inertial reference frames.
- The acceleration of an object interacting with other objects can be predicted by using aFm= Σ .

Students will be skilled at…

- designing a plan for collecting data to measure gravitational mass and to measure inertial mass and to distinguish between the two experiments
- applying F=mg to calculate the gravitational force on an object
- using Newton's law of gravitation to calculate the gravitational force between two objects and use that force in contexts involving orbital motion
- connecting the concepts of gravitational force and electric force to compare similarities and differences between the forces

Unit 8: Simple Harmonic Motion

Timeline: 2 weeks

Transfer Goal:

- Ask questions, recognize and define problems, and propose solutions.
- Safely and ethically collect, analyze, and evaluate appropriate data.
- Utilize, create, and analyze models to understand the world.
- Make valid claims and informed decisions based on scientific evidence.
- Effectively communicate scientific reasoning to a target audience.

Students will know…

- When a linear restoring force is exerted on an object displaced from an equilibrium position, the object will undergo a special type of motion called simple harmonic motion.
- Potential energy exists within a system if the objects within that system interact with conservative forces.
- The internal energy of a system includes the kinetic energy of the objects that make up the system and the potential energy of the configuration of the objects that make up the system.

Students will be skilled at…

- predicting which properties determine the motion of a simple harmonic oscillator and what the dependence of the motion is on those properties
- designing a plan and collect data in order to ascertain the characteristics of the motion of a system undergoing oscillatory motion caused by a restoring force
- constructing a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force

Unit 9: Mechanical Waves and Sound

Timeline: 3 weeks

Transfer Goals:

- Ask questions, recognize and define problems, and propose solutions.
- Safely and ethically collect, analyze, and evaluate appropriate data.
- Utilize, create, and analyze models to understand the world.
- Make valid claims and informed decisions based on scientific evidence.
- Effectively communicate scientific reasoning to a target audience.

Students will know…

- A Wave is a travelling disturbance that transfers energy and momentum. (CBEU6.A)
- A periodic wave is one that repeats as a function of both time and position and can be described by its amplitude, frequency, wavelength, speed, and energy. (CBEU6.B)
- Only waves exhibit interference and diffraction (CBEU6.C)
- Interference and superposition lead to standing waves and beats (CBEU6.D)

Students will be skilled at…

- using a visual representation to construct an explanation of the distinction between transverse and longitudinal waves by focusing on the vibration that generates the wave
- using graphical representation of a periodic mechanical wave to determine the amplitude of the wave
- constructing an equation relating the wavelength and amplitude of a wave from a graphical representation of the electric or magnetic field value as a function of position at a given time instant and vice versa
- designing a suitable experiment and analyze data illustrating the superposition of mechanical waves
- planning data collection strategies, predict the outcome based on the relationship under test, perform data analysis, evaluate evidence compared to the prediction, explain any discrepancy and, if necessary, revise the relationship among variables responsible for establishing standing waves on a string or in a column of air

Unit 10: Electrostatics: Electric Charge and Electric Force

Timeline: 3 weeks

Transfer Goals:

- Ask questions, recognize and define problems, and propose solutions.
- Safely and ethically collect, analyze, and evaluate appropriate data.
- Utilize, create, and analyze models to understand the world.
- Make valid claims and informed decisions based on scientific evidence.

- Effectively communicate scientific reasoning to a target audience.

Students will know…
- Electric charge is a property of an object or system that affects its interactions with other objects or systems containing charge.
- At the macroscopic level, forces can be categorized as either long-range (action-at-a-distance) forces or contact forces.
- Certain quantities are conserved, in the sense that the changes of those quantities in a given system are always equal to the transfer of that quantity to or from the system by all possible interactions with other systems.

Students will be skilled at…
- making predictions, using the conservation of electric charge, about the sign and relative quantity of net charge of objects or systems after various charging processes, including conservation of charge in simple circuits
- using Coulomb's law qualitatively and quantitatively to make predictions about the interaction between two electric point charges
- connecting the concepts of gravitational force and electric force to compare similarities and differences between the forces
- defining open and closed systems for everyday situations and apply conservation concepts for energy, charge and linear momentum to those situations

Unit 11: DC Currents (Resistors only)

Timeline: 3 weeks

Transfer Goals:
- Ask questions, recognize and define problems, and propose solutions.
- Safely and ethically collect, analyze, and evaluate appropriate data.
- Utilize, create, and analyze models to understand the world.
- Make valid claims and informed decisions based on scientific evidence.
- Effectively communicate scientific reasoning to a target audience.

Students will know…
- Electric charge is a property of an object or system that affects its interactions with other objects or systems containing charge.
- Materials have many macroscopic properties that result from the arrangement and interactions of the atoms and molecules that make up the material.
- The energy of a system is conserved.
- The electric charge of a system is conserved.

Students will be skilled at…
- making predictions, using the conservation of electric charge, about the sign and relative quantity of net charge of objects or systems after various charging processes, including conservation of charge in simple circuits
- constructing or interpreting a graph of the energy changes within an electrical circuit with only a single battery and resistors in series and/or in, at most, one parallel branch as an application of the conservation of energy (Kirchhoff 's loop rule)
- designing an investigation of an electrical circuit with one or more resistors in which evidence of conservation of electric charge can be collected and analyzed
- using a description or schematic diagram of an electrical circuit to calculate unknown values of current in various

segments or branches of the circuit