EL DORADO UNION HIGH SCHOOL DISTRICT
EDUCATIONAL SERVICES

Course of Study Information Page

COURSE TITLE **Physics**		
DISTRICT COURSE NUMBER **0330**		4-DIGIT STATE COURSE CODE (COMPLETED BY SILT) **2613**
Rationale:	Upper level science course primarily for students planning to major in engineering, medical, architecture, research, etc. fields.	
Course Description that will be in the Course Directory:	This course is designed for students who wish to understand the functions and applications of motion, forces, energy, heat, sound, electromagnetic radiation, and electricity. It satisfies the Physical Science graduation requirement.	
How Does this Course align with or meet State and District content standards?	This course addresses all standards for secondary school Physics (grades 9-12, PS2-4), as well as the science and engineering practices.	
NCLB Core Subjects:	*Select up to two that apply:* ☐Arts ☐Civics and Government ☐Not Core Subject ☐Economics ☐History ☐English ☐Mathematics ☐Foreign Language ☐Reading / Language Arts ☐Geography X Science	
CDE CALPADS Course Descriptors: (See Page 2 for Definitions)	CTE TECH PREP COURSE INDICATORS ☐ Tech Prep (32) (Higher Ed) ☐ Tech Prep & ROP(33) (Higher Ed) ☐ ROP (30) X N/A	CTE COURSE CONTENT CODE ☐ CTE Introductory (01) ☐ CTE Concentrator (02) ☐ CTE Completer (03) ☐ Voc Subject X N/A
		INSTRUCTIONAL LEVEL CODE ☐ Remedial (35) ☐ Honors UC-Certified (39) ☐ Honors Non UC-Certified (34) ☐ College (40) X N/A
Length of Course:	X Year ☐Semester	
Grade Level(s):	☐9 X 10 X 11 X 12	
Credit:	X Number of credits: 5 units each semester X Meets graduation requirements (Physical Science) ☐ Request for UC "a–g" requirements CSU/UC requirement **d**	☐College Prep
Prerequisites:	Concurrent enrollment in Algebra 2 or higher is required. Completion of Chemistry highly recommended.	
Department(s):	Science	
District Sites:	ORHS, PHS, EDHS, UMHS	
Board of Trustees COS Adoption Date:	April 14, 2009	
Textbooks / Instructional Materials:	Walker, James S., *Physics*: Pearson, 2014. ISBN: 9780132957038	

Funding Source:	General
Board of Trustees Textbook Adoption Date:	May 9, 2017

Definitions

CALPADS	California Longitudinal Pupil Achievement Data System
CTE Technical Prep	A course within a CTE technical career pathway or program that has been articulated with a postsecondary education or through an apprenticeship program of at least 2 years following secondary instruction.
Instructional Level Code	Represents a nonstandard instructional level at which the content of a specific course is either above or below a 'standard' course instructional level. These levels may be identified by the actual level of instruction or identified by equating the course content and level of instruction with a state or nationally recognized advanced course of study, such as IB or AP.
Instructional Level Honors, UC Certified	Includes all AP courses.
Instructional Level Honors, non UC Certified	Requires Board approval.
Instructional Level College	Includes ACE courses. Equivalent to college course and content, but not an AP course. Not related to section, but to course.

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Course Title: Physics

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Department: **Science**

Course Title: **Physics**

Unit Title: **Forces and Motion**

Content Area Standards

HS-PS2-1 Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

HS-PS2-2 Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

HS-PS2-3 Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.* [*Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.*]

Unit Outline:

Science Skills. Students will exhibit knowledge of the vocabulary of measurement and will correctly use and convert units in the metric system (SI) and express values in scientific notation. Students will demonstrate correct measurement and recording techniques, and create and interpret graphs using appropriate technologies. Additionally, students will show awareness of sources of error, and properly report percent error.

Kinematics. Students will properly use the vocabulary of motion: position, displacement, speed, velocity, acceleration, etc. They will use Newton's equations to solve problems involving uniformly accelerated motion in one or two dimensions. Students will resolve vectors into components, and add two vectors to find their resultant. Students will solve for the trajectory of projectiles. Students will solve for acceleration and speed of objects in circular motion.

Newton's Laws of Motion. Students will differentiate between field and contact forces, and show both when drawing Free Body Diagrams. They will demonstrate knowledge of Newton's Three Laws of Motion by a) solving equilibrium problems b) solving acceleration problems c) resolving and adding force vectors. Students will resolve vectors into their components, and add three or more vectors to find their resultant. They will exhibit knowledge of specific forces: a) weight, b) friction, c) tension and/or elasticity, d) normal force, e) centripetal force. Students will make predictions about motion using Newton's Laws.

Momentum. Students will be able to calculate the momentum of an object, and demonstrate changes in momentum due to impulse in an open system, and conservation of momentum in a closed system. Students will be able to differentiate between elastic and inelastic collisions. Students mathematically describe how changes in motion relate to forces and momentum They engage in a design challenge to reduce the effects of a collision.

Instructional Strategies:

Students will participate in direct instruction including demonstration problems, followed by guided and then individual practice. Graphing, drawing, and diagramming skills will be frequently utilized and developed.

Students will complete lab activities including: measuring motion, graph matching, projectile trajectories (**HS-PS2-1**), coefficients of friction (**HS-PS2-1)**, Hooke's Law, and collisions (**HS-PS2-2**).

Students will build, test, and refine vehicles to protect an egg during a collision (**HS-PS2-3**).

Algebra and geometry concepts will be reviewed and reinforced as needed.

Assessments: May include, but not limited to:

Frequent checks for understanding will be used, including warm-ups, guided practice and classwork, lab reports, homework quizzes, and computer simulations (formative) and written chapter/unit/final exams (summative).

Formative:

1. Measure your height, convert to cm, m, km.
2. Lab activity and written report to demonstrate measurement, recording and graphing techniques (Saxon Bowls, Graphical Analysis, etc.).
3. Lab activity: Electric cars.
4. Calculate v_i and v_f of a marble rolling off your desktop.
5. Lab activity: Vector treasure hunt.
6. Vector A = 56.7 m north, vector B = 22.4 m east. Add both vectors.

Summative:

1. Solve, include correct labels and significant figures: 34.7m/103.6s = ?
2. Given v_i=0, v_f=15.5m/s and Δt=6.6s, calculate Δx and acceleration. ($v_f = v_i + a\Delta t$, $vf^2 = vi^2 + 2a\Delta x$)
3. An ice skater with an initial velocity of 12m/s glides to a stop in 100.0m. Calculate the coefficient of friction between her skates and the ice. ($vf^2 = vi^2 + 2a\Delta x$, $F=ma$, $\mu_k = F_k/F_N$)
4. Calculate the final velocity in a perfectly inelastic collision between a 1200 kg car traveling 21 m/s rear-ended by a 4500 kg truck traveling at 29 m/s in the same direction. ($p=mv$)

Interventions: May include, but not limited to:

Each school has varied intervention resources: Peer tutoring, post-test review, after school remedial sessions, review sessions for unit and final exams, computer tutorial software, online resources (Physics applets), and supplementary textbook materials.

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Department: **SCIENCE**

Course Title: **PHYSICS**

Unit Title: **TYPES OF INTERACTIONS**

Content Area Standards:

HS-PS2-4 Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

HS-PS2-5 Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

HS-PS3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to interaction.

Unit Outline:

Newton's Law of Universal Gravitation. Students explore how gravity changes as we leave the vicinity of Earth, and replace the familiar weight formula with Newton's gravity equation. Forces between planets and the sun are calculated. Orbits are introduced.

Electrostatics & Coulomb's Law. Students will demonstrate an understanding of electric charge and its relation to force (Coulomb's Law). Students will demonstrate an understanding of the behavior of electric fields and their relation to electric forces. Gravitational and Electric fields are compared and contrasted.

Electric Circuits. Voltage, current, and resistance are introduced. Students build simple circuits and verify Ohm's Law. Students investigate relationships between resistors in series and in parallel.

Magnetic Induction. Students build electromagnets and measure magnetic flux. They build speakers from simple solenoids connected to various surfaces, and demonstrate how a changing current can induce fluctuations in magnetic fields. Generators and motors are also investigated.

Instructional Strategies:

Students will participate in direct instruction including demonstration problems, followed by guided and then individual practice. Graphing, drawing, and diagramming skills will be frequently utilized and developed.

Students will complete lab activities including: drawing field lines (**HS-PS3-5**), analyzing planetary data (**HS-PS2-4**), van de Graaff generators (**HS-PS3-5**), Ohm's Law, series & parallel circuits, electromagnets (**HS-PS2-5**).

Students will build and evaluate a speaker that can be attached to a radio to convert electric current into magnetic fields and produce sound waves (**HS-PS2-5**).

Algebra and geometry concepts will be reviewed and reinforced as needed.

Assessments: May include, but not limited to:

Frequent checks for understanding will be used, including warm-ups, guided practice and classwork, lab reports, homework quizzes, and computer simulations (formative) and written chapter/unit/final exams (summative).

Formative:

1. Activity: predict motions of charged objects.
2. Build a circuit with three resistors and a power supply. Draw a schematic diagram and use Ohm's Law (V=IR) to calculate volts, ohms, amps, and watts. Use a digital VOM to verify your calculations.
3. Predict the direction of current flow in a wire and direction of the magnetic field. Use a compass to verify. (Right hand rule)

Summative:

1. Calculate the force on a particle with a charge of +2.5μC in a 25 N/C electric field. ($E = F_e/q_0$)
2. Two resistors in parallel (15Ω, 25Ω) are connected across 15 V. Calculate current and amps in each resistor and equivalent resistance ($1/R_t = 1/R_1 + 1/R_2$, V=IR)
3. A transformer is used to increase 120 V to 2400 V. If the primary has 75 turns, calculate the number of secondary windings. ($N_2/N_1 = \Delta V_2/\Delta V_1$)

Interventions: May include, but not limited to:

Each school has varied intervention resources: Peer tutoring, post-test review, after school remedial sessions, review sessions for unit and final exams, computer tutorial software, online resources (Physics applets), and supplementary textbook materials.

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Department: **SCIENCE**

Course Title: **PHYSICS** Course Number: **0330**

Unit Title: **ENERGY**

Content Area Standards

HS-PS3-1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

HS-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-PS3-4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

HS-PS3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to interaction.

Unit Outline:

Work & Energy. Students will be able to calculate work, power, and kinetic energy. Students will exhibit an understanding of the relationship between work and changes in kinetic energy. Students will be able to demonstrate how machines provide mechanical advantage by changing force, but not total work accomplished.

Potential Energy. Students will be able to calculate various forms of potential energy: gravitational potential, spring potential, electric potential, etc. Students will become familiar with conservative forces, which store potential energy, and non-conservative forces, which create thermal energy.

Conservation of Energy. Students will be able to demonstrate conservation of energy between the various forms. Laboratory activities should investigate relationships between kinetic energy, gravitational potential, elastic potential. Friction and thermal energy may or may not be included in labs.

Thermal Energy, Internal Energy & Heat. Students will be able to relate thermal energy to other forms of energy, and to the conservation laws. They will be able to demonstrate the relationship between heat, internal energy, and temperature. Students will demonstrate understanding of the first and second laws of thermodynamics by calculating changes in heat, work and entropy in engines. Laboratory investigation of the gas laws will reveal how pressure, temperature, and volume relate to work, heat, and internal energy.

Instructional Strategies:

Students will participate in direct instruction including demonstration problems, followed by guided and then individual practice. Graphing, drawing, and diagramming skills will be frequently utilized and developed.

Students will complete lab activities including: simple machines (**HS-PS3-1**), Hooke's Law (**HS-PS3-2**), calorimetry (**HS-PS3-4)**, electric generators (**HS-PS3-5)**, Hero's engine, Boyle's Law, Charles' Law (**HS-PS3-1**).

Students will build and analyze a machine that converts stored energy into motion (**HS-PS3-3)**.

Algebra and geometry concepts will be reviewed and reinforced as needed.

Assessments: May include, but not limited to:

Frequent checks for understanding will be used, including warm-ups, guided practice and classwork, lab reports, homework quizzes, and computer simulations (formative) and written chapter/unit/final exams (summative).

Formative:

1. Lab activity: walk, trot, run upstairs, calculate your power in Watts and Horsepower (work=mgh, power=work/Δt)
2. Calculate v_f for an object dropped from 5.6 m above the ground using conservation of energy principles ($mgh=\frac{1}{2}mv^2$)
3. Lab activity: Flip pennies, calculate probabilities and actual outcomes for head/tails, relate to entropy.

Summative:

1. Calculate the loss in kinetic energy in a perfectly inelastic collision between a 1200 kg car traveling 21 m/s rear-ended by a 4500 kg truck traveling at 29 m/s in the same direction. ($KE=\frac{1}{2}mv^2$)
2. Calculate final temperature of a 100.0 C aluminum ball dropped into 50.0 mL of 15.0 C water. ($\Delta Q=mc\Delta T$)

Interventions: May include, but not limited to:

Each school has varied intervention resources: Peer tutoring, posttest review, after school remedial sessions, review sessions for unit and final exams, computer tutorial software, online resources (Physics applets), and supplementary textbook materials.

EDUCATIONAL SERVICES

Department: **SCIENCE**

Course Title: **PHYSICS** Course Number: **0330**

Unit Title: **WAVES & ELECTROMAGNETIC RADIATION**

Content Area Standards

HS-PS4-1 Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

HS-PS4-2 Evaluate questions about the advantages of using digital transmission and storage of information.

HS-PS4-3 Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

HS-PS4-4 Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

HS-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

Unit Outline:

Properties of Waves. Students investigate relationships between wavelength, frequency, and speed of waves. Reflection, refraction, and diffraction in different wave media are explained. Students experiment with constructive and destructive interference and amplitude. Students will be able to demonstrate common phenomena of waves including standing waves, beats, and the Doppler Effect.

Sound Waves. Wave properties are reinforced as they apply to sound waves in air and water. Students measure the speed and intensity of sound waves. Students can demonstrate properties of sound such as frequency (pitch) and resonance. Students can demonstrate a knowledge of harmonics and resonance, as they apply to musical sounds.

Light, Color, and Optics. Wave interactions are reinforced as they apply to waves of visible light. Students experiment with reflection (mirrors), refraction (lenses), and diffraction. Laboratory activities should investigate both particle models of light and wave models of light.

Electromagnetic Radiation. Students investigate the EM spectrum, with an emphasis on differences between ionizing and non-ionizing radiation. Einstein's photoelectric effect is introduced. Students also study technologies such as solar cells, MRI scans, and radio/microwave communications. Online simulations (PhET) are used to illustrate how these devices work.

Instructional Strategies:

Students will participate in direct instruction including demonstration problems, followed by guided and then individual practice. Graphing, drawing, and diagramming skills will be frequently utilized and developed.

Students will complete lab activities including: sound capture and analysis, measuring the speed of sound (**HS-PS4-1**), wave interference lab, harmonics/overtones lab, ray tracing with an optics bench, diffraction gratings (**HS-PS4-3)**.

Students will read about and evaluate various types of information transmission and storage, specifically the difference between analog and digital (**HS-PS4-2)**. Students will read about different types of EM radiation to understand the differing effects they have on matter. Students will discuss common observations of EM radiation including using a microwave and sunburns.

Students will read about different ways that waves are used to transmit and capture energy. They will build, and describe the functioning of a simple radio (**HS-PS4-5)**.

Students will build or analyze a musical instrument (**HS-PS4-1**).

Algebra and geometry concepts will be reviewed and reinforced as needed.

Assessments: May include, but not limited to:

Frequent checks for understanding will be used, including warm-ups, guided practice and classwork, lab reports, homework quizzes, and computer simulations (formative) and written chapter/unit/final exams (summative).

Formative:

1. Lab activity: stretch out slinky springs on the floor, record wave velocities, interference and reflections.
2. Predict pipe lengths for harmonics in a closed tube. ($f_n = nv/4L$, n=1, 3, 5…)
3. Calculate the wavelength of various radio station waves from their frequencies. ($v=f\lambda$)
4. Lab activity: Measure the object and image distances using a lens, then verify by calculation. ($1/p + 1/q = 1/f$)

Summative:

1. Calculate the power of a sound source that measures 80.0 dB at 5.00 m. ($dB = 10 \log (I/I_0)$, $I=power/4\pi r^2$)
2. Draw a ray diagram for an object 15 cm in front of a mirror of f=+25cm. Calculate the magnification. ($m= -q/p = h_i/h_0$)

Interventions: May include, but not limited to:

Each school has varied intervention resources: Peer tutoring, post-test review, after school remedial sessions, review sessions for unit and final exams, computer tutorial software, online resources (Physics applets), and supplementary textbook materials.