NGSS Conceptual Physics/Geoscience GRADE 9 DRAFT DESERT SANDS UNIFIED SCHOOL DISTRICT

Course Overview

Text Source(s): The California Science Framework

"Physics of the Universe" Discovery Education

COURSE TITLE TBD		
	Big Ideas (Enduring Understanding)	How do the Physics , and Earth and Space Science Universal Laws affect me and everything around me? All behavior in the universe can be explained by these universal physical laws.
	Topics of Study (story line)	Storyline: Physics, and Earth and Space Science study how matter and energy relate to each other. They generate fundamental knowledge needed for the future technological advances that will continue to drive the economic engines of the world, and understanding resources of the earth, and the universe, including how to manage them. Sequence of Instructional Strands: 1. Forces & Motion 2. Forces At a Distance 3. Waves and Electromagnetic Radiation 4. Energy Conservation And Renewable Energy 5. Nuclear Processes and Earth History 6. Stars and the Origins of the Universe 7. Weather, Climate, Hydrology, and the Rock Cycle
	Essential Questions by Instructional Strand (IS)	**IS #1: Forces and Motion** 1. How can Newton's Laws be used to explain how things move? 2. How can Vectors be used to describe motion including wind speed and directions? 3. How can mathematical models of these laws be used to test and improve engineering designs? 4. How can Newton's Laws explain the formation of the solar system? 5. How can Newton's Law explain the motions of celestial bodies? (Nebular Theory) **IS #2: Forces At A DIstance** 1. How can different objects interact when they are not touching? 2. How can Newton's Laws explain the motion of celestial bodies? 3. How do Rotational forces affect the motion of objects? 4. How do magnetic forces affect objects? **IS #3: Waves and Electromagnetic Radiation** 1. How is information transmitted wirelessly? 2. What is the effect of electromagnetic radiation on the human body? 3. How can we use waves to determine the interior structure of the Earth? 4. How do stars produce energy, connect to matter, and produce elements? (convection, conduction, radiation) 5. How is energy transmitted through the earth in wave form? (p waves, s waves, magnetic field)

6. How does the study of light provide evidence of the Big Bang?
7. How does red-shift differ from blue shift?

IS #4: Energy Conservation and Renewable Energy

1 .How do Power plants generate electricity?
2. What engineering designs can help increase the efficiency of our electricity production and reduce the impacts of using fossil fuel?
3. How do electricity, conduction, induction, and convection affect energy transfer?
4. What are renewable and non-renewable energies?
5. How is climate changing over time and to what extent do humans impact change?(Greenhouse effect).
6. How is energy conserved and transferred?
7. What device converts one form of energy to another? (PS3-3)
8. How does the water cycle affect energy conservation and renewal?

IS #5: Nuclear Processes and Earth History

1. What is the significance of E = mc2?
2. How do nuclear reactions illustrate the Conservation of Energy and Mass?
3. How do we determine the age of rocks and other geologic features?(Dating)
4. How does plate tectonics explain formation of continents, mountains, and other Earth features? (ESS1-4, 5 PS2-3)
5. How does the movement of plates cause earthquakes and volcanoes? (ESS1-5)
6. How do the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay affect earth? .PS1-8

IS #6: Stars and The Origins of the Universe

1. What is the composition of the stars?
2. What powers stars and cause longevity?
3. What are the differences between stars, and how are the patterns in motion of the stars reveal the Origin of our Universe? (Kepler's Laws)
4. How can Newton's Law explain the motions of celestial bodies?
5. Where do heavy elements come from? (ESS1-3)
6. .How does the study of light provide evidence of the Big Bang?(ESS1-2, PS4-5)
7. How does Impact Theory affect the Moon's creation phases?

IS #7: Principles of Geoscience

1. How do we determine the age of rocks and other geologic features?(Processes)
2. How do wind and water current affect weather, climate and the atmosphere?
3. How does the movement, distribution and management of water affect the Earth?
4. What are the effects of ocean salinity on the Earth?
5. How does the cycling of carbon affect the hydrosphere, atmosphere, geosphere, biosphere, and the evolution of life on Earth? (ESS2-6,7 Cycles)

	Evidence Statements	**NGSS Performance Expectations (Clarification Statements)**	**Essential Outcomes**	**Laboratory Exercises/Activities**
IS 1 F o r c e + M o t i o n	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. [Clarification Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. 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. [Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle. 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.* [Clarification Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it.	https://www.nextgenscience.org/dci-arrangement/hs-ps2-motion-and-stability-forces-and-interactions	**Analyze data to support the mathematical relationship of the physical laws. Apply science and engineering ideas to design, evaluate, and refine devices that demonstrate the physical laws. Communicate scientific and technical information.**	Toy cars, slot cars, acceleration cars Lab Cart on a ramp: measure acceleration with motion detector Graph matching: dt & vt graph interpretation Vernier motion detector for development of F=ma (push and pull a cart - as force changes acceleration changes in a linear manner with a mass slope. Could be compared to free fall constant force situations for deeper understanding.) Collision Carts: Using motion detectors for a variety of collisions Egg smash survival: Create a device that reduces the force on an object by increasing the length of time that the force acts during the collision. Culminating Task with Geo and Physics content, CER write up (ask GEO for ideas) Displacement sketches/practice Online Orbiting simulator from PHet

	Examples of a device could include a football helmet or a parachute. HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. [Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons. HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS1-4%20Evidence%20Statements%20June%202015%20asterisks.pdf https://www.nextgenscience.org/dci-arrangement/hs-ets1-engineering-design		

IS 2 F o r c e + D i s t a n c e	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. [Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields. HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors. HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. [Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons	https://www.nextgenscience.org/dci-arrangement/hs-ps4-waves-and-their-applications-technologies-information-transfer https://www.nextgenscience.org/dci-arrangement/hs-ess2-earths-systems	***I can apply Newton's Law of Gravitation to calculate and predict gravitational forces between two objects.*** ***I can apply Coulomb's Law to calculate and predict electrostatic forces between two objects.*** ***I can conceptually explain similarities and differences between Newton's Law of Gravitation and Coulomb's Law.*** ***I can describe a graph of an inverse square relationship.*** ***I can draw accurate diagrams of magnetic field lines for a bar magnet and current carrying wire in a variety of shapes.*** ***I can explain the difference between conductors and insulators at the atomic level.*** ***I can calculate the velocity and orbital radius of an orbiting satellite/planet.*** ***I can predict the changes in orbital characteristics due to changes in mass, velocity, and radius.*** ***I can provide evidence from a lab that supports the principle that an***	Drawing activity for Kepler's planetary orbits Electrostatics lab: various modeLs Inverse square law: Vernier lab #29 Car attached to string for circular motion Engineering: Design and build a stronger electromagnet (battery, nail, wire) Evidence-based Writing:Why Tides change? What would happen if the sun disappeared? Building electromagnet Build an energy conversion devices: various models Energy conservation lab: Vernier motion detector: dropped ball

IS 3	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-PS3-2. 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 positions of particles (objects). [Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations. 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.* [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.] HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces		***electric current can produce a magnetic field.*** ***I can provide evidence from a lab that supports the principle that a changing magnetic field can produce an electric current.*** ***I can calculate the gravitational potential energy and kinetic energy of an object at different places in its motion and see that the total energy is conserved.*** ***I can describe how thermal energy affects particle movement and relate this boiling water.*** ***I can explain the role of magnetic fields in the generation of electricity in power plants.*** ***I can design and build a device that converts mechanical energy to electrical energy.*** ***I describe how a solar cell/panel converts solar energy into electrical energy.*** ***I can effectively communicate with the use of graphs and other tools to illustrate the factors related to***	Basic Circuit Lab/activity KidWind activities Electromagnetic Lab: extend to build a motor (optional) Magnetic field sensor labs…… Engineering: Build a device that converts one energy form into mechanical energy(windmill, solar car, steam boat, etc) (Rube Goldberg Machine, wind turbine) Evidence-based Writing: 1. Fossil Fuels: How can we eliminate them? 2. Renewable energy is too costly to replace fossil fuels.

Waves	between objects and the changes in energy of the objects due to the interaction. [Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other. 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.* [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology. HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* [Clarification Statement: Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen. HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources,		***climate change, biodiversity collapse, or clean water shortages and possible solutions to this problem.***	Mine Chocolate chip cookies….Phyllis Marchese LQHS Groundwater resources: Water resource simulator (Morgan Sowell) Solar Power) Power resources (Morgan Sowell)

	the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] HS-ETS1-1, 2, 3, 4			

IS 4	HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	https://www.nextgenscience.org/dci-arrangement/hs-ps4-waves-and-their-applications-technologies-information-transfer	***I can provide evidence from a lab showing how waves travel differently through different materials.***	PHet Wave simulation Earthquake: speed of waves from TRAC day PHet photoelectric simulation Poster on the uses of different light

	[Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth. HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information. [Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft. 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. [Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect. 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. [Clarification		***I can explain the differences between different kinds of electromagnetic radiation in terms of energy.*** ***I can evaluate the advantages of using digital transmission of data and information, and provide examples of this technology.*** ***I can evaluate claims, evidence and reasoning behind the idea that electromagnetic radiation can behave as both a wave and a particle, and say when each is useful depending on the situation.*** ***I can describe how some forms of electromagnetic radiation can be harmful to people, and evaluate claims related to this.***	waves…. Solar energy activity Communications: wireless, wifi, am/fm, UV light with beads……various materials, sunscreen Student research on radiation and the human body...collaborative activity Waves and the earth activities: work with Geo. Teachers “Mission to Mars”: Darin and Hannah Engineering: Build a device/building to minimize the effects of seismic waves during an earthquake.

	Statement: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias. 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.* [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. [Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion).	https://www.nextgenscience.org/dci-arrangement/hs-ess2-earths-systems	***I can describe and model how polarized lenses apply the principles of wave behavior.*** ***I can develop a model to explain how wave behavior can be seen in earthquakes***	Stream Table Activities? Seafloor Contour Map San Diego Earthquake Unit….(Darin M.) http://www.csun.edu/~mdalessio/dalessio/Research_in_Geoscience/Research_in_Geoscience.html
IS 5	HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion,	https://www.nextgenscience.org/dci-arrangement/hs-ps1-matter-and-its-interactions	***I can explain the similarities and differences between fission, fusion,***	Atomic structure activity…..PHet Simulation

	and radioactive decay. [Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations. HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. [Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages of oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust decreasing with distance away from a central ancient core of the continental plate (a result of past plate interactions). HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. [Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and	https://www.nextgenscience.org/dci-arrangement/hs-ess1-earths-place-universe	***and radioactive decay and provide examples of each.*** ***Relate the difference in mass between reactants and products in nuclear processes to the energy produced according to E = mc²*** ***Recognize that plates exist in the earth's crust and move relative to one another. Friction between plates can be stored and lead to geological phenomenon such as earthquakes and volcanic activity.*** ***I can provide evidence of the history of our solar system using radiometric dating, sizes, composition, and impact cratering on the surface.***	Nuclear Fission and Fusion…..PHet Simulation Rock age analysis….application activity Convection currents from the earth's core……Heat byproduct Radioactive speed dating: text "Get a Half-life" - text Engineering: need to develop activities Evidence-based Writing: need to be developed Stream Table Activities: you can build a stream table yourself!

	the impact cratering record of planetary surfaces. HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. [Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion.	https://www.nextgenscience.org/dci-arrangement/hs-ess2-earths-systems	***I can develop a model to explain how wave behavior can be seen in earthquakes***	
IS 6	HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy in the form of radiation. [Clarification Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries. HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra,	https://www.nextgenscience.org/dci-arrangement/hs-ess1-earths-place-universe	***I can describe the life cycle of the Sun and build a model to show how the sun produces energy in its core.*** ***I can build a model for the origins of the universe using light spectra, motion of distance galaxies, and composition of matter present in the universe.***	Spectroscopy: diffraction glasses, star composition website from Hannah Gas tube Lab Flame lab Phet simulation or online simulation for Red and Blue Shift Create HR diagrams, and plot stars Bright lights: text Need activity for Big Bang Engineering:

	motion of distant galaxies, and composition of matter in the universe. [Clarification Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium). HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements. [Clarification Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.] [Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of different masses are not assessed.]		***I can explain what the doppler effect is in relation to the expansion of the universe and the effects it has on light.*** ***I can explain how stars produce different elements over their life cycles and use the emission spectra to show this.***	Culminating activity: Mars Challenge: how would you get your people from Mars to the Space Station, proposal to NASA
IS 7	HS-ESS2-1. Develop a model to illustrate how Earth's internal surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. HS-ESS2-2. Analyze geoscience data to make the claim that changes to Earth's surfaces can create feedback that cause changes to other earth systems.	https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-1%20Evidence%20Statements%20June%202015%20asterisks.pdf https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-2%20Evidence%20Statements%20June%202015%20asterisks.pdf		

	HS-ESS2-3.Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.	https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-3%20Evidence%20Statements%20June%202015%20asterisks.pdf		
Performance Task	**Assessment of Standards (Summative)**	Quarter 1 (F): Quarter 2 (F): Quarter 3 (F): Quarter 4 (F): Summative (1): Summative (2):	Links to performance tasks	