	PU	SD Science District Instructional Guide	es (Date Updated: 01/0	01/2020)		
Grade Level: High School		Time: 29 days				
Unit Title: Kinematics, Graphing, and Tracker Software		Essential Questions: How are an object's velocity, location, acceleration, and time related to one another? How can motion be represented verbally, graphically, and algebraically? What measurement and data analysis techniques will give us access to data about a real object's motion.				
		Phenomena:				
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments	
U1, U2, U3 P2, P3, P4	Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function	Given a description of an object's motion, I can solve for an unknown quanity by selecting the proper equation. Given a motion graph of x, v, or a, I can draw the other two graphs. I can use Tracker to analyze motion in a video, graph the data in a spreadsheet, and interpret the trendline equation to identify acceleration and velocity. I can calculate horiontal launch projectile motion problems.	Force Distance Position Displacement Time Speed Velocity Acceleration Instantaneous vs average (speed) Kinematic equations Free Fall Projectile Trajectory Scalar Vector Resultant Velocity	Space Jump https://thewonderofscience. com/phenomenon/2018/7/7/felix-baumgartner-space- jump-world-record Finger Safe saw https://www.ngssphenomena.com/finger-safe-saw/		
Details			Core Ideas for Using Science			
			U1: Scientists explain evidence obtained fro or scientific investigati lead to developing mo theories to make sens As new evidence is di and theories can be rr U2: The knowledge pr used in engineering a solve problems and/o U3: Applications of sc positive and negative economic, and/or politi	m observations and ions. Evidence may odels and or se of phenomena. scovered, models evised. roduced by science is nd technologies to r create products. ience often have both ethical, social,		

	PUS	D Science District Instructional Guide	s (Date Updated: 01/0	01/2020)		
Grade Level: High School		Time: 17 days (round 1) + 8 days (round 2 with vectors)				
Unit Title: Newton's Laws		Essential Questions: Why do objects move the way they do? What role does inertia play in motion? How can the rules of free body diagams aid in setting up a Newton's second law problem?				
		Phenomena:				
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments	
p66 Physics – P2: Objects can affect other objects at a distance. Motion & Stability – Forces & Interactions Essential HS.P2U1.5 Construct an explanation for a field's strength and influence on an object (electric, gravitational, magnetic). p67 Physics – P3: Changing the movement of an object requires a net force to be acting on it. Motion & Stability – Forces & Interactions Essential HS.P3U1.6 Collect, analyze and interpret data regarding the change in motion of an object or system in one dimension, to construct an explanation using Newton's Laws. Plus HS+Phy.P3U1.3 Develop a mathematical model, using Newton's laws, to predict the motion of an object or system in two dimensions (projectile and circular motion). Essential HS.P3U2.7 Use mathematics and computational thinking to explain how Newton's laws are used in engineering and technologies to create products to serve human ends.	Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function	I can identify the forces present in a situation, use judgement about whether to include friction and air resistance, and draw a free body diagram. I can apply Newton's 2nd law in both x and y directions to solve for unknown forces.	Newton Mass Weight Inertia Force Acceleration Vector Gravity Vector Scalar Friction Normal force Angle	Inertia: Sled: https://www.ngssphenomena. com/sleddinginertia/ Egg + broom stick Which string will break Leaves on a net: http://ingur.com/NeUUspE, http: //questic.org/phenomena/physics-page-2.html Cooked vs raw egg: https://thewonderofscience. com/phenomenon/2018/7/11/raw-or-boiled-egg- experimentdex Hovercraft / chrome cart / Normal Force vs Weight: Scale in an elevator Friction - sailing stones https://www.ngssphenomena.com/sailinstones/ 3rd law truck tug of war https://www.youtube.com/watch? v=pnoRc43qcZY&feature=youtu.be		
			Core Ideas for Using			
Details			Science			
p66 Newton's second law accurately p macroscopic objects, but it require speeds close to the speed of light	es revision for subatomic scales or for		U1: Scientists explain evidence obtained fro or scientific investigati lead to developing mo theories to make sens	m observations and ions. Evidence may odels and or se of phenomena.		

po/ Newton's second law accurately predicts changes in the motion of macroscopic objects, but it requires revision for subatomic scales or for speeds close to the speed of light.	As new evidence is discovered, models and theories can be revised. U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products. U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.	

PUSD Science District Instructional Guides (Date Updated: 01/01/2020)						
Grade Level: High School		Time: 12 days				
Unit Title: Energy		Essential Questions: What types of energy are present in a given situation? How can conservation of energy help us use observable data to calculate missing information?				
	1	Phenomena:	1			
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments	
p68 Physics – P4: The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event. Energy & Waves Essential HS.P4U1.8 Engage in argument from evidence that the net change of energy in a system is always equal to the total energy exchanged between the system and the surroundings. Essential HS.P4U3.9 Engage in argument from evidence regarding the ethical, social, economic, and/or political benefits and liabilities of energy usage and transfer. Plus HS+Phy.P4U1.6 Analyze and interpret data to quantitatively describe changes in energy within a system and/or energy flows in and out of a system. Plus HS+Phy.P4U2.7 Design, evaluate, and refine a device that works within given constraints to transfer energy within a system.	Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function	I can identify which types of energy are present in a situation and create a conservation of energy equation that will allow me to solve for for a missing quanity. I can apply the concept of work as a transfer of energy and mechanical work as F*d to relate energy problems to forces.	Work Power Energy Conservation Potential Mechanical Energy Chemical Kinetic Force Distance Horsepower Watt Joule Newton	Histoy of the transition from caloric to energy http://galileoandeinstein.physics.virginia. edu/more_stuff/TeachingHeat.htm Images http://www.eoht.info/page/Cannon+boring+experiment Importance of observing phenomena (S-P effect) https://en.wikipedia. org/wiki/An_Experimental_Enquiry_Concerning_the_S ource_of_the_Heat_which_is_Excited_by_Friction Permanent magnet doesn't run out of energy (W=Fd) Magnet fan debunked https://www.youtube.com/watch?v=AaC1kuBdkzo Magician tip: why use X, why not Y? Rube goldberg filmed up side down https://thewonderofscience. com/phenomenon/2018/7/8/amazing-rube-goldberg- machines Honda Cog commercial rube goldberg Spring Forces - slinky free-fall https://www.ngssphenomena.com/slinky-free-fall/ Really this illustrates how/why/when to incorporate the mass of a spring which we typically ignore. Elasticity: arrow vs concrete https://thewonderofscience. com/phenomenon/2018/7/8/slow-motion-golf-ball- collision https://thewonderofscience. com/phenomenon/2018/7/8/slow-motion-golf-ball- collision https://thewonderofscience. com/phenomenon/2018/7/8/slow-motion-golf-ball- collision https://thewonderofscience. com/phenomenon/2018/7/8/slow-motion-golf-ball- collision https://thewonderofscience. com/phenomenon/2018/7/8/slow-motion-golf-ball- collision https://thewonderofscience. com/phenomenon/2018/7/8/slow-motion-golf-ball- collision https://thewonderofscience. com/phenomenon/2018/7/8/slow-motion-golf-ball- collision		
Details			Core Ideas for Using Science			

		 U1: Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised. U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products. U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications. 		
Sequence				
Do caloric theory history after calculating conservaation of energy equations because the evidence against caloric theory requires making comparisons to other forms of energy.				
Start with individual phenomena, then rube goldbergs or other way around?				

PUSD Science District Instructional Guides (Date Updated: 01/01/2020)							
Grade Level: High School		Time: 7 days					
Unit Title: Momentum		Essential Questions: How are Newton's laws and momentum related to one another? How do objects behave during a collisoin? How does the concept of an isolated or non-isolated system impact the way momentum is analyzed?					
	1	Phenomena:		11			
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments		
p66 Physics – P2: Objects can affect other objects at a distance. Motion & Stability – Forces & Interactions Essential HS.P2U1.5 Construct an explanation for a field's strength and influence on an object (electric, gravitational, magnetic). p67 Physics – P3: Changing the movement of an object requires a net force to be acting on it. Motion & Stability – Forces & Interactions Essential HS.P3U1.6 Collect, analyze and interpret data regarding the change in motion of an object or system in one dimension, to construct an explanation using Newton's Laws. Plus HS+Phy.P3U1.4 Engage in argument from evidence regarding the claim that the total momentum of a system is conserved when there is no net force on the system. Essential HS.P3U2.7 Use mathematics and computational thinking to explain how Newton's laws are used in engineering and technologies to create products to serve human ends. Plus HS+Phy.P3U2.5 Design, evaluate, and refine a device that minimizes or maximizes the force on a macroscopic object during a collision.		consevatin of momentum. I can identify whether a system is isolated or not and whether to analyze a problem using momentum or energy.	Force Time Mass Velocity Inelastic collision Elastic collision Momentum Impulse Conservation Recoil	Momentum - why don't woodpeckers get concussions https://thewonderofscience. com/phenomenon/2018/4/30/why-dont-woodpeckers- get-concussions https://www.ngssphenomena.com/woodpecker- slowmo/ killer asteroids https://thewonderofscience. com/phenomenon/2018/7/9/protecting-the-earth-from- killer-asteroids Energy + momentum: Newton's cradle (why can't one ball go twice as high?) Einstein's Big Idea video. What makes a car safe? Why wear helmets? Why do you follow through when hitting a baseball? Aluminum vs wood bats Long range artillery Padded gloves vs. bare hands Why do rockets move in space? Why are you safer in a Hummer vs a Smart Car? Figure skater pulling in arms			

system, total momentum is always	lar imes the velocity of the object. In any conserved. If a system interacts with nentum of the system can change:	Core Ideas for Using Science U1: Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena.	
	nced by changes in the momentum of	As new evidence is discovered, models and theories can be revised. U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products. U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.	

	PUSD Science District Instructional Guides (Date Updated: 01/01/2020)					
Grade Level: High School		Time:				
Unit Title: Circular Motion		Essential Questions: How do Newton's Laws apply to circuilar motion? What are the misconceptions sorrounding centrifugul force and what is the proper use of centripetal force?				
		Phenomena:				
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments	
p66 Physics – P2: Objects can affect other objects at a distance. Motion & Stability – Forces & Interactions Essential HS.P2U1.5 Construct an explanation for a field's strength and influence on an object (electric, gravitational, magnetic). p67 Physics – P3: Changing the movement of an object requires a net force to be acting on it. Motion & Stability – Forces & Interactions Essential HS.P3U1.6 Collect, analyze and interpret data regarding the change in motion of an object or system in one dimension, to construct an explanation using Newton's Laws. Plus HS+Phy.P3U1.3 Develop a mathematical model, using Newton's laws, to predict the motion of an object or system in two dimensions (projectile and circular motion). Essential HS.P3U2.7 Use mathematics and computational thinking to explain how Newton's laws are used in engineering and technologies to create products to serve human ends.	Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function	Identify when a circular motion problem should be approached using Newton's laws vs conservation of energy.	Radius Orbit Velocity Acceleration Motion Force Centripetal Centrifugal Uniform circular motio Angular Degree Gravity	escape from a cone https://www.ngssphenomena.com/physics-escape/ human loop https://www.ngssphenomena.com/human-loop/ Phenomena Neutron stars Orbits of planets Why are roller coasters so much fun? Centrifuge g-forces Car safety - going around curves - why do you spin out? Leverage		
			Core Ideas for Using			
interactions of matter and radiation within that called energy is	of a system that depends on the motion and system. That there is a single quantity al energy is conserved, even as, within the		Science U1: Scientists explain evidence obtained fror or scientific investigati lead to developing mo theories to make sens As new evidence is dis and theories can be re	n observations and ons. Evidence may dels and or e of phenomena. scovered, models		

is continually transferred from one object to another and between its various possible forms. At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. "Mechanical energy" generally refers to some combination of motion and stored energy in an operating machine. "Chemical	U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products. U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.	

	PUSD Science District Instructional Guides (Date Updated: 01/01/2020)						
Grade Level: High School		Time: 4 days	Time: 4 days				
Unit Title: Special Relativity		Essential Questions: What is an objects 'true' speed? How are length and the rate of time altered by velocity? How are clasic paradoxes resolved?					
		Phenomena:					
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments		
U1, U2, U3 P2, P3, P4	Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function			Relativity https://www.ngssphenomena.com/who-moves-sky-or- us/			
Details							

	PUS	SD Science District Instructional Guide	es (Date Updated: 01/0	1/2020)		
Grade Level: High School		Time:				
Unit Title: Fluid Statics		Essential Questions: How are pressure and depth related? How large is the buoyancy force on an object? How are mass, density, volume, and buoyancy related to each other?				
		Phenomena:				
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments	
U1, U2, U3 P2, P3, P4	Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function	Do calculations using the pressure/depth equation. Use the buoyacy equation and spot conceptual relationships between the variables in it with other information (for instance, that when an object is floating, the weight = buoyancy)	density, buoyancy, mass, weight, pressure, volume, archimedes principle, submerged	bed of nails https://www.youtube.com/watch? v=P1zfktn4AzU&feature=youtu.be		
Details			Core Ideas for Using Science			
			U1: Scientists explain evidence obtained froi or scientific investigati lead to developing mo theories to make sens As new evidence is di and theories can be re U2: The knowledge pr used in engineering at solve problems and/or U3: Applications of sci positive and negative economic, and/or polit	m observations and ons. Evidence may dels and or se of phenomena. scovered, models evised. roduced by science is nd technologies to r create products. ience often have both ethical, social,		

PUSD Science District Instructional Guides (Date Updated: 01/01/2020)					
	Time:				
	Essential Questions: What are laminar and turbulent flow and separation and how are they related to drag? How is lift generated on a wing? How can Bernoulli's principle predict pressures around an objecect and what are it's limitations? How should streamline information from a wind tunnle be interpreted? Phenomena:				
Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments	
Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function	Analyze a streamline diagram for areas of high or low speed. Apply Bernoulli's principle to identify high and low pressure. Identify exceptions to Bernoulli's principle. Explain how a wing generates lift using both Bernoulli's principle and conservation of momentum. Identify factors that increase or dedcrease drag, including separation and turbulence.	Laminar, turbulent, bernoulli, separation, drag, lift, streamline, viscosity	Bike rider laying flat, aerodynamics https://www.ngssphenomena.com/bike-aerodynamics/ Bernoulli Basketball https://www.youtube.com/watch? v=QtP_bh2IMXc&feature=youtu.be		
		Core Ideas for Using Science			
		evidence obtained fro or scientific investigati lead to developing mo theories to make sens As new evidence is di and theories can be re U2: The knowledge pr used in engineering a solve problems and/ou U3: Applications of sc positive and negative	m observations and ons. Evidence may idels and or se of phenomena. scovered, models evised. oduced by science is nd technologies to r create products. ience often have both ethical, social,		
	Cross Cutting Concepts Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and	Time: Essential Questions: What are laminar and turbulent flow a How is lift generated on a wing? How can Bernoulli's principle predic How should streamline information fr Phenomena: Cross Cutting Concepts Objectives (I Can) Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function Analyze a streamline diagram for areas of high or low speed. Apply Bernoulli's principle to identify high and low pressure. Identify exceptions to Bernoulli's principle. Explain how a wing generates lift using both Bernoulli's principle and conservation of momentum. Identify factors that increase or dedcrease drag, including separation	Time: Essential Questions: What are laminar and turbulent flow and separation and he How is lift generated on a wing? How can Bernoulli's principle predict pressures around an How should streamline information from a wind tunnle be Phenomena: Cross Cutting Concepts Objectives (I Can) Key Vocabulary Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function Analyze a streamline diagram for areas of high or low speed. Apply Bernoull's principle to identify high and low pressure. Identify exceptions to Bernoull's principle. Explain how a wing generates lift using both Bernoull's principle and Conservation of momentum. Identify factors that increase or dedcrease drag, including separation and turbulence. Core Ideas for Using Science U1: Scientiste explain evidence obtained from streamline diagram or vidence obtained from streamline diagram for and turbulence. U1: Scientiste explain evidence obtained for or scientific investigation and turbulence.	Time: What are laminar and turbulent flow and separation and how are they related to drag? How is lift generated on a wing? How should streamline information from a wind tunnle be interpreted? Cross Cutting Concepts Objectives (I Can) Key Vocabulary Resources (Activities/Lessons/Experiments) Crosscuting Concepts: Patterns; Cause and effect; Scale, Proportion and duantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function Analyze a streamline diagram for areas of high or low speed. Apply Bernoull's principle to identify high and low pressure. Udentify exoptions to Bernoull's principle and conservation of momentum. Udentify factors that increase or dedcrease drag, including separation and turbulence. Bike rider laying flat, aerodynamics https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ both Bernoull's principle and conservation of momentum. Identify factors that increase or dedcrease drag, including separation and turbulence. Bike rider laying flat, aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.ngssphenomena.com/bike-aerodynamics/ https://www.n	

PUSD Science District Instructional Guides (Date Updated: 01/01/2020)					
Grade Level: High School Time:					
Unit Title: Electrostatics and Gravity	Essential Questions: How are static electricity and gravity similar to each other? What are voltage, electric field, electrc force, and elecctric potential energy; how are they related to each other and how are they different? How can invisible abstract concepts be represented graphically? Phenomena:			and how are they	
Standards Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments	

p66 Physics – P2: Objects can affect other objects at a distance. Motion & Stability – Forces & Interactions Essential HS.P2U1.5 Construct an explanation for a field's strength and influence on an object (electric, gravitational, magnetic). p67 Physics – P3: Changing the movement of an object requires a net force to be acting on it. Motion & Stability – Forces & Interactions Essential HS.P3U1.6 Collect, analyze and interpret data regarding the change in motion of an object or system in one dimension, to construct an explanation using Newton's Laws. Plus HS+Phy.P3U1.2 Develop and use mathematical models of Newton's law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects p76 Earth and Space – E2: The Earth	Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function	Calculate relationships between voltage, electric field, electrc force, and elecctric potential energy. Know when to use the law of superposition and when not to. Draw and interpret diagrams of electric fields and equipotential lines. Describe similarities between electricity and gravity. Calculate gravitational force and gravitation field using Newton's Universal Gravitation Equation. Use the Universal Gravitation Equation in conjunction with circular motion equations to calculate simple orbits.	Magnetic Field Electric Field Charge Resistance Battery Ohm Watt Coulomb Volt Ampere Circuit Electrical Potential Electrostatic	Electrostatics: Lightning https://www.ngssphenomena.com/statue-of-lightning/ Lightning High voltage discharges Van de Graff generator Cotton and polyester blankets pulled appart in a dark room. Electroscope needle attracts to a charged object vs compass needle to a magnet - how are electricity and magnetism different? Disassemble a lyden jar Clacking Can static electricity demo compelation https://www.youtube.com/watch?v=ViZNgU-Yt-Y Gravity Phenomena: Cavendish experiment https://thewonderofscience. com/phenomenon/2018/7/12/cavendish-experiment Harder to hit the sun than it is to leave the solar system 1) https://www.youtube.com/watch?v=LHvR1fRTW8g 2) https://www.youtube.com/watch?v=dhDD2KaflSU	
Earth and Space – E2: The Earth and our solar system are a very small part of one of many galaxies within the Universe. Earth and the Solar System Essential HS.E2U1.16 Construct an explanation of how gravitational forces impact					
the evolution of planetary motion Plus HS+E.E2U1.13 Analyze and interpret data showing how gravitational forces are influenced by mass, and the distance between objects. Plus HS+E.E2U1.14 Use mathematics and computational thinking to					
explain the movement of planets and objects in the solar system.			Core Ideas for Using Science		
p66	·····		U1: Scientists explain	phenomena using	

Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. Forces at a distance are explained by fields permeating space that can transfer energy through space. Magnets or changing electric fields cause magnetic fields; electric charges or changing magnetic fields cause electric fields. 4 (p. 116) p76 Planetary motions around the sun can be predicted using Kepler's three empirical laws, which can be explained based on Newton's theory of gravity. These orbits may also change somewhat due to the gravitational effects from, or collisions	 evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised. U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products. U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications. 	
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PUSD Science District Instructional Guides (Date Updated: 01/01/2020)						
Grade Level: High School		Time:				
Unit Title: Magnetism		Essential Questions: How does a permanent magnet work How is electricity related to a magnet How does a changing magnetic field	tic field?			
		Phenomena:				
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments	
966 Physics – P2: Objects can affect other objects at a distance. votion & Stability – Forces & interactions Essential HS.P2U1.5 Construct an explanation for a ield's strength and influence on an object (electric, gravitational, magnetic). Plus HS+Phy.P2U1.1 Plan and carry out investigations o design, build, and efine a device that works within given constraints to demonstrate that an electric current can produce a magnetic field and that a direct of the statement	Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function	Explain how permanent magnets work. Use the right hand rule to identify the direction of a magnetic field produced by a current. Use Lenz' law to identify the direction of an induced current and induced magnetic field. Use the right hand rule to analyze the relationship between the direction of force and current. Predict the resulting motion.	Magneti Magnetic Field Electric Field Charge Resistance Battery Ohm Watt Coulomb Volt Ampere Circuit Electrical Potential Electrostatic	Energy and Magnetism: assemble magnetic cannon challenge https://thewonderofscience. com/phenomenon/2017/10/8/ps2-motion-and-stability- forces-and-interactions Magnet on Monitor levitating and melting and curie temperature https://www.ngssphenomena.com/levitation-melting/ induction cooker cut in half doesn't cook where there is no pot https://www.youtube.com/watch? v=T3Al1eQ50iE&feature=youtu.be Maglev trains Lenz law demonstration		
-			Core Ideas for Using			
Details Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. Forces at a distance are explained by fields permeating space that can transfer energy through space. Magnets or changing electric fields cause magnetic fields; electric charges or changing magnetic fields cause electric fields. 4 (p. 116)			Science U1: Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised. U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products. U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.			

PUSD Science District Instructional Guides (Date Updated: 01/01/2020)						
	Time:					
	Essential Questions: Where will current flow in a circuit? How much current and potential difference will be present for a given circuit element? How do resistors behave? How to capacitors behave?					
1	Phenomena:	1				
Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments		
Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function	Explain the behavior of parallel and series resistor circuits. Calculate equivalent resistance of a circuit. Conceptually describe the role of a capacitor in a circuit. Be able to make analogies between circuits and the flow of water through pipes with different elevations and with paddle wheels or spongges in the pipes.	Resistance, current, voltage, potential, Ohm's Law, series, parallel	Digital circuits kits Lightbulb circuit kits			
		Core Ideas for Using				
		U1: Scientists explain evidence obtained from or scientific investigati- lead to developing mo- theories to make sens As new evidence is di- and theories can be re- U2: The knowledge pr- used in engineering an solve problems and/on- U3: Applications of sci positive and negative	n observations and ons. Evidence may dels and or e of phenomena. scovered, models evised. oduced by science is nd technologies to create products. ence often have both ethical, social,			
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	PUSD Science District Instructional Guides (Date Updated: 01/01/2020)						
Grade Level: High School		Time:					
Unit Title: Waves and Sound		Essential Questions: What are the universal features of waves. How are the universal features of waves manifested in the case of sound and how are they percieved? How do constructive and destructive interference of different configurations account for a variety of audio phenomena? What is the dopplar effect and why does it happen?					
		Phenomena:					
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments		
p89 Physics – P4: The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event. Energy & Waves Essential HS.P4U1.10 Construct an explanation about the relationships among the frequency, wavelength, and speed of waves traveling in various media, and their applications to modern technology.	Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function	Describe the frequency and wavelength of a sound. Use the concepts of constructive interference and distructive interference to explain beats, standing waves, and square waves. Apply the doppler effect concept to both sound and light.	Transverse Longitudinal Velocity Sound Mechanical Medium Pitch Volume Resonance Amplitude Frequency Wavelength	Strobe Effect (Waves) https://www.ngssphenomena.com/spinnerdirection/			
Details			Core Ideas for Using Science				
p60 The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. The reflection, refraction, and transmission of waves at an interface between two media can be modeled on the basis of these properties. Combining waves of different frequencies can make a wide variety of patterns and thereby encode and transmit information. Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent			U1: Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised. U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products. U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.				

PUSD Science District Instructional Guides (Date Updated: 01/01/2020)						
Grade Level: High School		Time:				
Unit Title: Light and Waves		Essential Questions: How are the universal features of waves manifested in the case of light and how are they percieved? How do constructive and destructive interference result in double-slit interference patterns? How is light produced by emission lines and by black body radiation?				
		Phenomena:				
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments	
p89 Physics – P4: The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event. Energy & Waves Essential HS.P4U1.10 Construct an explanation about the relationships among the frequency, wavelength, and speed of waves traveling in various media, and their applications to modern technology.	Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function	Apply wave concepts to light to explane interference patterns. Identify whether light was produced by emission lines or black body radiation and compare the spectra of them.	Color/ROYGBIV Spectrum Wavelength Frequency c = speed of light Amplitude	Doppler effect - fire truck going by Why is the sky blue? Why do you get cancer? Why do you get a sunburn?		
Details			Core Ideas for Using Science			
Details p60 The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. The reflection, refraction, and transmission of waves at an interface between two media can be modeled on the basis of these properties. Combining waves of different frequencies can make a wide variety of patterns and thereby encode and transmit information. Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent			U1: Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised. U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products. U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.			

	PUSD Science District Instructional Guides (Date Updated: 01/01/2020)					
Grade Level: High School	Grade Level: High School Time:					
Unit Title: Quantum Mechanics		Essential Questions: What is the role of probability in quantum phenomena? What is an electron cloud and how does it relate to a particle in a box? How does radioactive decay relate to a particle in a box? What is the experimental evidenece that light is a wave (especially interference patterns) and what is evidence that light is a particle (especially the photoelectric effect)				
	1	Phenomena:	1			
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments	
U1, U2, U3 P2, P3, P4	Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function	Use the phenomena of double slit interfence as explanation and proof of the observer effect, based on cause and effect (not metaphysics). Explain how the quantum model of the atom is based on the phenomea of emission lines.	Probability, interference, observer, wave function, Schrodinger's cat, Heisenberg uncertainty principle			
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PUSD Science District Instructional Guides (Date Updated: 01/01/2020)						
Grade Level: High School		Time:				
Unit Title: Astronomy,Cosmology, and Nuclear Reactions		Essential Questions: How are nuclear reactions related to star life cycles? What happens to a star when the nuclear fuel is consumed? What evidence is the big bang theory based on?				
		Phenomena:				
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments	

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Details		
p75 Our Sun is one of many stars that make up the Universe, essentially made of	Core Ideas for Using Science	
hydrogen. The source of energy that the Sun and all stars radiate comes from nuclear reactions in their central cores. The Sun is one of millions of stars that	U1: Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may	
together make up a galaxy called the Milky Way. 2 (p. 25) Nearly all observable matter in	lead to developing models and or theories to make sense of phenomena.	
the universe is hydrogen or helium, which formed in the first minutes after the Big	As new evidence is discovered, models and theories can be revised.	
Bang. Elements other than these remnants of the Big Bang continue to form within the	U2: The knowledge produced by science is used in engineering and technologies to	
cores of stars. Nuclear fusion within stars produces all atomic nuclei lighter than and	solve problems and/or create products. U3: Applications of science often have both	
including iron, and the process releases the energy seen as starlight. Heavier	positive and negative ethical, social, economic, and/or political implications.	
Scientific understanding can help to identify implications of certain applications but decisions about whether certain actions should be taken will		
require ethical and moral judgements which are not provided by knowledge of science. There is an important difference between the understanding that		
science provides about, for example, the need to preserve biodiversity, the factors leading to climate change and the adverse effects of harmful		
substances and lifestyles, and the actions that may or may not be taken in relation to these issues. Opinions may vary about what action to take but arguments based on scientific evidence should not be a matter of opinion. 2		
(p. 33) The total number of neutrons plus protons does not change in any nuclear process. Strong and weak nuclear interactions determine nuclear		
stability and processes. Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric		
dating to be used to determine the ages of rocks and other materials from the		

	PUSD Science District Instructional Guides (Date Updated: 01/01/2020)					
Grade Level: High School		Time:				
Unit Title:		Essential Questions:				
		Phenomena:				
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments	
Details						
Details						

PUSD Science District Instructional Guides (Date Updated: 01/01/2020)												
Grade Level: High School		Time:										
Unit Title:		Essential Questions: Phenomena:										
Standards	Cross Cutting Concepts	Objectives (I Can)	Key Vocabulary	Resources (Activities/Lessons/Experiments)	Assessments							
U1, U2, U3 P2, P3, P4	Crosscutting Concepts: Patterns; Cause and effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and change; Structure and function											
Details												

p66 The application of science in making new materials is an example of how scientific knowledge has led advances in technology and provided engineers with a wider choice in designing constructions. At the same time technological advances have helped scientific developments by improving instruments for observation and measuring, automating processes that might otherwise be too dangerous or time consuming to undertake, and particularly through the

AP Thermo - drinking bird https://hewonderdfscience.com/phenomenon/2017/10/7/drinking-bird Ray optics: Invisibility fluid https://www.ngsperberomena.com/invisible-polymer/																	
Ray optics - blacker than wanta https://www.youtube.com/watch?v=00CYc_mC3Uo Ray optics - arrow reversal https://www.napsehormenan.com/obsing-through-water/																	
Wave optics - UV camera https://thewonderchiceince.com/phenomenon/20184/23/how-the-sun-sees-you https://www.ngsptheromena.com/ur-sun-damage/ Sound -recover adds form motion in a video (connect to big bang audio)																	
https://thewonderofacience.com/phenomenon/2018/7/8/the-visual-microphone-passive-recovery-of-sound-from-video Quantum - Photoelectic effect https://thewonderofacience.com/phenomenon/2018/7/7/photoelectric-effect																	
Nisc: https://hewonderofscience.com/phenomenon2018/7/8/ht/droic-prism https://hewonderofscience.com/phenomenon2018/7/8/eff-leveling-pool-table-on-cruise-ship https://www.ngsenberonena.com/pipel-asteroid/ https://hewonderofscience.com/phenomenon/2018/7/9/programmable-droplets-from-mit																	
Circuits is part of the standards and fluids are not. But fluids are better suited for a standard physics level and circuits are	better suited for an AP	physics level, meaning th	t circuits require a lot	of nitty gritty calcu	lations that aren't r	much fun unless t	he student eniov	s that kind of thing	2. whereas fluids f	as interesting rea	I world connection	s without much calculations which	is perfect for Sta	ndard but would ne	ed to be cut as "r	not something that	at will be on the ter