Map: **Physics** Grade Level: **11**

District: **Island Trees**

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	Essential Questions	Content	Skills		Standards/PIs
Unit 1	Why is the SI system useful? Why is a vector used in certain physical instances? Why is a scalar used in certain physical instances? How do displacement and distance differ? How do velocity and speed differ? How is acceleration related to velocity? How is free-fall acceleration identified? Why do objects with different masses fall with the same acceleration? How are the kinematic equations used? How do you pick the correct equation to solve a particular kinematics problem?	***KINEMATICS*** ENERGY AND MATTER INTERACT THROUGH FORCES THAT RESULT IN CHANGES IN MOTION. Kinematic equations. Position-time graphs. Velocity-time graphs. ***Vocabulary:*** Vector, scalar,displacement, distance, velocity, speed, acceleration.	Identify physical quantites in terms of vectors and scalars. Calculate displacement, distance, velocity, speed, and acceleration. Determine displacement, velocity, and acceleration from graphical data. Use of the kinematic equations. Interpretation of the position-time graphs. Interpretation of the velocity-time graphs. Construction of displacement-time graphs, and velocity-time graphs. Incorporate free-fall acceleration in kinematic equations and graphs. Experimental measurements of displacement, velocity, and acceleration;		**MST1-K1-1A** **MST1-K2-1A** **MST1-K3-1A** **MST1-K4-2A** **MST1-K4-2D** **MST1-K5-2A** **MST1-K5-2C** **MST1-K5-2D** **MST1-K6-2A** **MST1-K6-2C** **MST1-K6-2D** **MST4-K5-5A**

			compare to theory.			
Unit 2	How do contact and non-contact forces differ? Why are force components used in a force diagram? How do inertial and gravitational mass differ? Why are inertial and gravitational mass quantitatively identical? How is friction useful in everyday life and in what ways is it less than useful? How can Newton's 3 laws be expressed in everyday language? How do weight and mass differ? How does mass and inertia relate? How does friction affect motion? Why is force a vector? Why is weight a vector?	***FORCES*** ENERGY AND MATTER INTERACT THROUGH FORCES THAT RESULT IN CHANGES IN MOTION. Vector diagrams. Force diagrams. Components and resultants. Equilibrants. Effects of the friction force. Vocabulary: Resultant, equilibrant.	Use vector diagrams to analyze mechanical systems (equilibrium and nonequilibrium). Verify Newton's Second Law for linear motion. Draw vector diagrams. Draw scaled force diagrams, using a ruler and a protractor. Construct force diagrams. Determine components and resultants. Experimentally measure forces and verify Newton's First and Second Law. Determine equilibrants theoretically and experimentally. Determine the effects of the friction force theoretically and experimentally. Experimentally determine the coefficient of friction for two surfaces.		**MST1-K1-1A** **MST1-K2-1A** **MST1-K3-1A** **MST1-K4-2A** **MST1-K4-2C** **MST1-K4-2D** **MST1-K5-2A** **MST1-K5-2C** **MST1-K5-2D** **MST1-K6-2A** **MST1-K6-2C** **MST1-K6-2D** **MST4-K4-4B** **MST4-K4-4B** **MST4-K5-5A**	

Unit 3	Why is motion independent in each of two dimensions? How do the dependencies of velocity and acceleration in the vertical and horizontal dimensions differ? Why is flight time only dependent on the vertical parameters? How and why is circular motion and centripetal acceleration dependent on centripetal force?	***TWO-DIMENSIONAL MOTION*** ENERGY AND MATTER INTERACT THROUGH FORCES THAT RESULT IN CHANGES IN MOTION. Two dimensional motion in the vertical and horizontal dimensions. Velocity and acceleration in the vertical and horizontal dimensions. Displacement in the vertical dimension and the horizontal dimension. Projectile flight	Separate two dimensional motion into the vertical and horizontal dimensions. Determine velocity and acceleration in the vertical and horizontal dimensions. Calculate displacement, and velocity in the vertical dimension and the horizontal dimension. Calculate and experimentally verify flight time, range, and altitude for projectile situations. Sketch the theoretical path of a projectile Apply Newton's Second Law for uniform circular motion Calculate centripetal		**MST1-K1-1A** **MST1-K2-1A** **MST1-K3-1A** **MST1-K4-2A** **MST1-K4-2D** **MST1-K5-2A** **MST1-K5-2D** **MST1-K5-2C** **MST1-K4-2A** **MST1-K4-2C** **MST1-K4-2D** **MST1-K5-2A** **MST1-K5-2C** **MST1-K5-2D**	

		time. Centripetal acceleration and centripetal force. ***Vocabulary:*** Centripetal, vertical, horizontal	acceleration and centripetal force.			

	Essential Questions	Content	Skills		Standards/PIs
Unit 4	How are impulse and momentum related? How does conservation of momentum relate to Newton's 3rd Law? How do kinetic and potential energies differ? How can momentum be increased or decreased? How can kinetic energy be increased or decreased? Why is impulse a vector? Why is momentum a vector? Why is momentum conserved? Why is potential energy path independent? Why is energy conserved?	***IMPULSE, MOMENTUM, ENERGY*** ENERGY AND MATTER INTERACT THROUGH FORCES THAT RESULT IN CHANGES IN MOTION. ENERGY EXISTS IN MANY FORMS, AND WHEN THESE FORMS CHANGE ENERGY IS CONSERVED. Impulse due to impacts. Collisions and explosions in terms of forces and	Determine impulse due to impacts. Analyze collisions and explosions in terms of forces and momentums. Calculate impulses and momenta in a variety of sports-related problems. Calculate and experimentally verify final velocities in explosions and collisons using conservation of momentum. Determine the factors that affect the period of a pendulum Analyze potential and kinetic energy of objects in static and dynamic situations.		**MST1-K1-1A** **MST1-K2-1A** **MST1-K3-1A** **MST1-K4-2A** **MST1-K4-2C** **MST1-K4-2D** **MST1-K5-2A** **MST1-K5-2C** **MST1-K5-2D** **MST1-K6-2A** **MST1-K6-2C** **MST1-K6-2D** **MST1-K6-2E** **MST4-K5-5A**

		momentums. Conservation of momentum. Work and power. Potential and kinetic energy of objects in static and dynamic situations. Conservation of energy. Vocabulary: Impulse, momentum, work,energy, potential, kinetic, conservation.	Describe, calculate, and experimentally determine the exchange between potential energy, kinetic energy, and internal energy for simple mechanical systems, such as a pendulum, a roller coaster, a spring, a freely falling object. Observe and explain energy conversions in real-world situations Recognize and describe conversions among different forms of energy in devices such as a motor, a generator, a photocell, a battery Compare the power developed when the same work is done at different rates. Analyze potential and kinetic energy of objects in static and dynamic situations. Verify conservation of energy				

Unit 5	How do electromagentic and mechanical waves differ? How do longitudinal waves and transverse wave differ? How do travelling waves and standing waves differ? How do waves act when they intersect? How do waves act at a boundary? How can a sound wave be generated? How can a sound wave be detected? Why can a sound wave not travel in a vacuum? Why does a sound wave	***WAVES*** ENERGY EXISTS IN MANY FORMS, AND WHEN THESE FORMS CHANGE ENERGY IS CONSERVED. Wavelength, wave velocity, and frequency. Longitudinal and transverse waves. In-phase and out-of-phase waves. Longitudinal and transverse waves. Identify nodes and antinodes.	Identify longitudinal and transverse waves. Explain in-phase and out-of-phase waves. Demonstrate longitudinal and transverse waves. Identify nodes and antinodes. Demonstrate waves reflections. Demonstrate standing waves. Measure wavelength, wave velocity, and frequency. Compare the characteristics of two transverse waves such as amplitude, frequency,		**MST1-K1-1A** **MST1-K2-1A** **MST1-K3-1A** **MST1-K4-2A** **MST1-K4-2B** **MST1-K4-2C** **MST1-K4-2D** **MST4-K4-4C** **MST4-K4-4A**	

	travel faster in certain media than in others? Why does the speed of sound depend on temperature?	Waves reflections. ***Vocabulary:*** Longitudinal, transverse, phase, wavelength, frequency, period, node, antinode.	wavelength, speed, period, and phase Draw wave forms with various characteristics Differentiate between transverse and longitudinal waves Determine the speed of sound in air Predict the superposition of two waves interfering constructively and destructively (indicating nodes, antinodes, in standing wave situations). Calculate transit time of light waves.			
	Why does a light ray bend as it enters a	***LIGHT***	Use the law of reflection and law of refraction to		**MST1-K1-1A** **MST1-K2-1A** **MST1-K3-1A** **MST1-K4-2A**	

Unit 6	transparant material or liquid? Why is an image distorted by a transparant material or liquid? Why are sun glasses polarized? How do optical fibers work?	ENERGY EXISTS IN MANY FORMS, AND WHEN THESE FORMS CHANGE ENERGY IS CONSERVED. Law of reflection and law of refraction. Total internal reflection. Dispersion. Diffraction. Polarization Electromagnetic spectrum. ***Vocabulary:*** Incident, reflection, refraction, diffraction, dispersion, critical, internal.	calculate light ray angles. Identify situations involving dispersion. Explain diffraction, polarization, dispersion, and total internal reflection. Discuss the electromagnetic spectrum. Observe, sketch, and interpret the behavior of wave fronts as they reflect, refract, and diffract. Draw ray diagrams to represent the reflection and refraction of waves. Determine the index of refraction of a transparent medium.		**MST1-K4-2D** **MST4-K4-4C** **MST4-K4-4A**	

	Essential Questions	Content	Skills		Standards/PIs
Unit 7	How are forces between electrons, between protons, between electrons and protons observed? How do electrons and protons move? How can we compare current flow to water flow? How can we compare voltage to pressure? Why is the flow of electicity similar to flow of water and how is it different? How is the best formula for calculating power chosen? How is electical power transferred in a circuit? How is electrical energy converted to heat energy? How does electrical resistance resemble restance to water flow?	***ELECTRICITY*** ENERGY AND MATTER INTERACT THROUGH FORCES THAT RESULT IN CHANGES IN MOTION. ENERGY EXISTS IN MANY FORMS, AND WHEN THESE FORMS CHANGE ENERGY IS CONSERVED. Electroscopes. Electrified pith balls. Electrostatic fields due to electric charges. Use of friction to generate net charge. Coulomb forces. Charging by contact and by induction. Electrical circuits; charge, cuurent, voltage, and resistance. Laws governing series and parallel circuits for the calculation of voltages and currents. Electrical power.	Use an electroscope. Use electrofied pith balls. Determine electrostatic fields due to electric charges. Use friction to generate net charge. Calculate coulomb forces. Explain and demonstrate charging by contact and by induction. Predict and experimentally determine electrostatic charge configurations in electroscopes and charged pith balls. Use voltage and current measurements to determine the resistance of a circuit element. Interpret graphs of voltage versus current. Measure and compare the resistance of conductors of various lengths and		**MST1-K1-1A** **MST1-K2-1A** **MST1-K3-1A** **MST1-K4-2A** **MST1-K4-2B** **MST1-K4-2C** **MST1-K4-2D** **MST1-K4-2A**

		Vocabulary: Electron, proton, electroscope,pith ball, induction, current, voltage series, parallel.	cross-sectional areas. Predict and verify the behavior of lightbulbs in series and parallel circuits. Construct simple series and parallel circuits Use the laws governing series and parallel circuits to calculate voltages and currents; compare calculations to experimental observations. Calculate electrical power in a variety of situations. Draw and interpret circuit diagrams which include voltmeters and ammeters.			
	How can magnetic fields be measured? How can magnetic fields be "seen"?	***MAGNETISM***			**MST1-K1-1A** **MST1-K2-1A** **MST1-K3-1A** **MST4-K4-4A**	

Unit 8	Why is the earth like a giant magnet? Why are the magnetic and geographic poles of the earth different? Why is the creation of a magnetic field by an electromagnet similar to the creation of a magnetic field by a moving charge?	ENERGY AND MATTER INTERACT THROUGH FORCES THAT RESULT IN CHANGES IN MOTION. ENERGY EXISTS IN MANY FORMS, AND WHEN THESE FORMS CHANGE ENERGY IS CONSERVED. Permanent and "non-permanent" magnets. Magnetic poles. Magnetic forces. Magnetic fields. Electromagnets. Atomic theory of magnetism. ***Vocabulary*** Magnetic, poles, electromagnet, solenoid, compass.	Map the magnetic field of a permanent magnet, indicating the direction of the field between the N (north-seeking) and S (south-seeking) poles. Map the magnetic field of an electromagnet. Identify magnetic forces acting on magnetic poles. Predict and sketch magnetic fields in a variety of magnetic configurations. Generate magnetic fields using electromagnets.		
Unit 9	Why does the photoelectric effect indicate that light has wave properties? Why does the Compton effect show that x-rays have particle properties? Why does Rutherford scattering support the nuclear model? Why was the Bohr model of the atom, revolutionary? Why does the	***MODERN PHYSICS*** ENERGY AND MATTER INTERACT THROUGH FORCES THAT RESULT IN CHANGES IN MOTION. Implications of the photoelectric effect.	Explain wave-particle dual behavior. Explain the implications of the photoelectric effect including E=hf. Explain the implications of the Compton effect. Analyze the differences between the plum pudding and nuclear model of the		**MST1-K1-1A** **MST1-K2-1A** **MST1-K3-1A** **MST4-K1-1B** **MST4-K4-4A** **MST4-K4-4C** **MST4-K4-4D** **MST4-K5-5A**

	bright-line spectrum of Hydrogen support the Bohr Model? Why was Einstein mass-energy equivalence revolutionary? How are subatomic particles, in the Standard Model, detected? How can something be a wave and a particle? How does the theory of relativity change our thinking about relative velocity and the laws of physics? Why and how do we think that the laws of physics continue to apply to extremely small particles?	Wave-particle dual behavior. Compton effect. Plum pudding and nuclear model of the atom. Bohr model of the atom. Electromagnetic radiation and absorption in an atom. Nuclear reactions using mass-energy equivalence and the conservation of charge. Subatomic particle laboratory measuring equipment such are bubble chambers, linear acclerators, and cyclotrons. Vocabulary: Duality, model, spectrum, bright-line spectrum, dark-line spectrum, radiation, absorption, equivalence, subatomic, lepton,hadron,baryon,meson,anti-matter, gluon,annihilation,beta particle,fermion,boson,uncertainty, exclusion.	atom. Explain the Bohr model of the atom. Interpret energy-level diagrams. Observe and correlate bright-line and dark-line spectral lines with an energy-level diagram. Calculate electromagnetic radiation and absorption in an atom. Analyze nuclear reactions using mass-energy equivalence and the conservation of charge. Describe subatomic particle laboratory measuring equipment such are bubble chambers, linear acclerators, and cyclotrons. Interpret standard model.		**MST4-K5-5B** **MST4-K5-5C**	

	Essential Questions	Content	Skills		Standards/PIs	
Unit 10	***REGENTS REVIEW*** How does a student do well on a Regents examination?	Review all physics material presented during the year.	Solve a variety of practice problems covering all aspects of the physics curriculum.			

Key to Standards used in this Map

MST1-K1-1A [9 occurences] - MST Standard 1 - Key Idea 1 [Mathematical Analysis i] - Performance Indicator 1A - use algebraic and geometric representations to describe and compare data. [Commencement]

MST1-K2-1A [9 occurences] - MST Standard 1 - Key Idea 2 [Mathematical Analysis ii] - Performance Indicator 1A - use deductive reasoning to construct and evaluate conjectures and arguments, recognizing that patterns and relationships in mathematics assist them in arriving at these conjectures and arguments. [Commencement]

MST1-K3-1A [9 occurences] - MST Standard 1 - Key Idea 3 [Mathematical Analysis iii] - Performance Indicator 1A - apply algebraic and geometric concepts and skills to the solution of problems. [Commencement]

MST1-K4-2A [9 occurences] - MST Standard 1 - Key Idea 4 [Scientific Inquiry i] - Performance Indicator 2A - elaborate on basic scientific and personal explanations of natural phenomena, and develop extended visual models and mathematical formulations to represent their thinking. [Commencement]

MST1-K4-2B [2 occurences] - MST Standard 1 - Key Idea 4 [Scientific Inquiry i] - Performance Indicator 2B - hone ideas through reasoning, library research, and discussion with others, including experts. [Commencement]

MST1-K4-2C [5 occurences] - MST Standard 1 - Key Idea 4 [Scientific Inquiry i] - Performance Indicator 2C - work toward reconciling competing explanations; clarifying points of agreement and disagreement. [Commencement]

MST1-K4-2D [8 occurences] - MST Standard 1 - Key Idea 4 [Scientific Inquiry i] - Performance Indicator 2D - coordinate explanations at different levels of scale, points of focus, and degrees of complexity and specificity and recognize the need for such alternative representations of the natural world. [Commencement]

MST1-K5-2A [5 occurences] - MST Standard 1 - Key Idea 5 [Scientific Inquiry ii] - Performance Indicator 2A - devise ways of making observations to test proposed explanations. [Commencement]

MST1-K5-2C [5 occurences] - MST Standard 1 - Key Idea 5 [Scientific Inquiry ii] - Performance Indicator 2C - develop and present proposals including formal hypotheses to test their explanations, i.e., they predict what should be observed under specified conditions if the explanation is true. [Commencement]

MST1-K5-2D [5 occurences] - MST Standard 1 - Key Idea 5 [Scientific Inquiry ii] - Performance Indicator 2D - carry out their research plan for testing explanations, including selecting and developing techniques, acquiring and building apparatus, and recording observations as necessary. [Commencement]

MST1-K6-2A [3 occurences] - MST Standard 1 - Key Idea 6 [Scientific Inquiry iii] - Performance Indicator 2A - use various means of representing and organizing observations (e.g., diagrams, tables, charts, graphs, equations, matrices) and insightfully interpret the organized data. [Commencement]

MST1-K6-2C [3 occurences] - MST Standard 1 - Key Idea 6 [Scientific Inquiry iii] - Performance Indicator 2C - assess correspondence between the predicted result contained in the hypothesis and the actual result and reach a conclusion as to whether or not the explanation on which the prediction was based is supported. [Commencement]

MST1-K6-2D [3 occurences] - MST Standard 1 - Key Idea 6 [Scientific Inquiry iii] - Performance Indicator 2D - based on the results of the test and through public discussion, they revise the explanation and contemplate additional research. [Commencement]

MST1-K6-2E [1 occurence] - MST Standard 1 - Key Idea 6 [Scientific Inquiry iii] - Performance Indicator 2E - develop a written report for public scrutiny that describes their proposed explanation, including a literature review, the research they carried out, its result, and suggestions for further research. [Commencement]

MST4-K1-1B [1 occurence] - MST Standard 4 - Key Idea 1 [Physical Setting i] - Performance Indicator 1B - describe current theories about the origin of the universe and solar system. [Commencement]

MST4-K4-4A [4 occurences] - MST Standard 4 - Key Idea 4 [Physical Setting iv] - Performance Indicator 4A - observe and describe transmission of various forms of energy. [Commencement]

MST4-K4-4B [2 occurences] - MST Standard 4 - Key Idea 4 [Physical Setting iv] - Performance Indicator 4B - explain heat in terms of kinetic molecular theory. [Commencement]

MST4-K4-4C [3 occurences] - MST Standard 4 - Key Idea 4 [Physical Setting iv] - Performance Indicator 4C - explain variations in wavelength and frequency in terms of the source of the vibrations that produce them, e.g., molecules, electrons, and nuclear particles. [Commencement]

MST4-K4-4D [1 occurence] - MST Standard 4 - Key Idea 4 [Physical Setting iv] - Performance Indicator 4D - explain the uses and hazards of radioactivity. [Commencement]

MST4-K5-5A [4 occurences] - MST Standard 4 - Key Idea 5 [Physical Setting v] - Performance Indicator 5A - explain and predict different patterns of motion of objects (e.g., linear and angular motion, velocity and acceleration, momentum and inertia). [Commencement]

MST4-K5-5B [1 occurence] - MST Standard 4 - Key Idea 5 [Physical Setting v] - Performance Indicator 5B - explain chemical bonding in terms of the motion of electrons. [Commencement]

MST4-K5-5C [1 occurence] - MST Standard 4 - Key Idea 5 [Physical Setting v] - Performance Indicator 5C - compare energy relationships within an atoms nucleus to those outside the nucleus. [Commencement]