Course: Physics **Grade: 11th and 12th** **Designer(s): Nicole Welsh**	**Overview of Course**: The course is designed to give academic students the necessary background in physics as to prepare him/her for college courses. The physics taught will be based on algebra and trigonometry with some calculus applications addressed by the end of the year. These math skills will be reviewed before applying them to solve problems. This course offers the general principles of physics. Students will apply these principals through activities such as laboratory exploration using computer probes, problem solving strategies, hands on activities, and critical thinking discussions. Students interested in a science career or engineering may benefit from this class.

Overarching Big Ideas, Enduring Understandings, and Essential Questions

Big Idea	Standard(s) Addressed	Enduring Understanding(s)	Essential Question(s) in Blue Important Questions in Black
Patterns	**S11.A.3.3**: Compare and analyze repeated processes or recurring elements in patterns.	By looking at a pattern one can relate one subject to the next in order to make predictions, describe, and explain the world around them.	1. From looking at patterns in your data in experiments, what conclusions can be made on physics theory and physics law? 2. PennDOT is working a stretch of road where there are constant accidents, from looking at data what patterns do you see causing the accidents. What physics phenomenon explains why this is happening?
Systems	**S11.A.3.1:** Analyze the parts of a simple system, their roles, and their relationships to the system as a whole.	When looking at systems one is able to see relationships and how these objects are interconnected as a whole.	1. The Earth is a complex system, from its motion, its tides, its weather, and its gravity. Compare the Earth as a system to a physics experiment that we did in class. Explain how the simple experiment represents something from the system of the Earth.
Analysis	**S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts.	When looking at scientific data, one can make a hypothesis on an outcome.	1. Looking back at experiments we did in class what types of information did we need to collect in order to make an accurate and precise analysis so that a

	S11.A.1.1.1: Compare and contrast scientific theories, scientific laws, and beliefs (e.g., the universal law of gravitation, how light travels, formation of moons, stages of ecological succession). **S11.A.1.1.2:** Analyze and explain the accuracy of scientific facts, principles, theories, and laws.		thorough conclusion can be made?
Exploration	**S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations.	Performing scientific experiments assists with everyday problem solving skills.	1. Pick a problem that you are confronted with, using the scientific method find a solution. What steps did you take? What observations did you make? What type of data did you collect? What conclusion can be made from your data and observations? What are some short falls of this experiment? If you were to do this experiment again what would you change?

Big Ideas, Enduring Understandings, and Essential Questions Per Unit of Study
(These do NOT "spiral" throughout the entire curriculum, but are specific to each unit.)

Week of Instruction (Tentative)	**Title of Unit**	**Big Idea(s)**	**Standard(s) Addressed**	**Enduring Understanding(s)**	**Essential Question(s)**	**Common Assessments**	**Common Resource(s)* Used**
Week .5	Nature of Science	**Patterns** **Exploration** **Analysis** Scientific Method	**S11.A.3.1:** Analyze the parts of a simple system, their roles, and their relationships to the system as a whole. **S11.A.3.2:** Compare observations of the real world to observations of a constructed model. **S11.A.3.3**: Compare and analyze repeated processes or recurring elements in patterns. **S11.A.1.1.1:** Compare and contrast scientific theories, scientific laws, and beliefs (e.g., the universal law of gravitation, how light travels, formation of moons, stages of ecological succession). **S11.A.1.1.2:** Analyze and explain the accuracy of scientific facts, principles, theories, and laws.	Scientists ask questions and conduct investigations to learn about the world around us.	1. What steps do scientists often use to solve problems? 2. Why do scientists use variables? 3. How could you apply the scientific method to a real life situation?	1. Scientific Method Lab 2. Quiz on Metric System and Measure-ment	

			S11.A.1.1.3: Evaluate the appropriateness of research questions (e.g., testable vs. not-testable). **S11.A.1.1.4:** Explain how specific scientific knowledge or technological design concepts solve practical problems (e.g., momentum, Newton's universal law of gravitation, tectonics, conservation of mass and energy, cell theory, theory of evolution, atomic theory, theory of relativity, Pasteur's germ theory, relativity, heliocentric theory, ideal gas laws). **S11.A.1.1.5:** Analyze or compare the use of both direct and indirect observation as means to study the world and the universe (e.g., behavior of atoms, functions of cells, and birth of stars).				
Week .5-2	Measurement	**Patterns** Measurement Systems	**S11.A.3.1:** Analyze the parts of a simple system, their roles, and their relationships to the system as a whole.	Measurement is a tool that is used every day in real life applications.	1. What is a standard of measurement? 2. What multiple of tens does each SI prefix represent? 3. What are the SI units	1. Measuring Metric Lab 2. Quiz on Metric System and Measure-	

			S11.A.3.3: Compare and analyze repeated processes or recurring elements in patterns**.** **M8.B.1.1.1:** Convert among metric measurements (milli, centi, kilo using meter, liter and gram) (table of equivalency provided on the reference sheet). **M8.B.1.1.2:** Convert customary measurements up to 2 units above or below the given unit (e.g., inches to yards, pints to gallons) (table of equivalency provided on the reference sheet). **M8.B.1.1.3:** Convert time up to 2 units above or below given unit (e.g., seconds to hours).		and symbols for length, volume, mass, time, temperature, and density? 4. How can related SI units be converted? 5. What real life objects are measured in the metric system? 6. What are the pros and cons of the metric system? 7. What is the difference between accuracy and precision?	ment	
Week 3	Mathematics Review	**Analysis** Solving for Variables Scientific Notation Significant Figures	**S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **M8.A.1.1.1:** Represent numbers using scientific notation and/or	Mathematics is a key element of physics that helps one better understand the theory behind physics.	1. How do you isolate a variable using algebraic expressions? 2. Why do we express number in scientific notion? 3. What is the purpose of significant figures?	1. Math Review Test	

			exponential forms. **CHEM.A.1.1.3:** Utilize significant figures to communicate the uncertainty in a quantitative observation. **A1.1.2.1.1:** Write, solve and/or apply a linear equation (including problem situations). **A1.1.2.1.2:** Use and/or identify an algebraic property to justify any step in an equation solving process (linear equations only). **A1.1.2.1.3:** Interpret solutions to problems in the context of the problem situation (linear equations only).				
Week 4	Graphing	**Patterns** Correlation **Analysis** Graphs	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts.	Graphs can be used to take observations and results in order to analyze data and to make predictions.	1. What are the three main types of graphs and how can to be used? 2. How are the independent and independent variable expressed in a graph? 3. How can you analyze data using the various types of graphs? 4. Why do scientist have a control variable?	1. Graphing Lab 2. Graphing Quiz	

			M11.D.2.1.2: Identify or graph functions, linear equations or linear inequalities on a coordinate plane. **M11.D.2.1.3:** Write, solve and/or apply a linear equation (including problem situations). **M11.D.4.1.1:** Match the graph of a given function to its table or equation.				
Weeks 5, 6, & 7	Motion In One Dimension Horizontal	**Analysis Patterns Exploration** Displacement Velocity Acceleration	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and	A motion occurs when an object changes its position.	1. How are displacement and distance different? 2. What is the difference between velocity and speed? 3. What is a scalar and a vector? 4. What real life variables are scalars or vectors? 5. How do you calculate velocity, and how is it related to time and displacement? 6. From looking a distance vs. time graph, what conclusions can be drawn? 7. What has to happen in order for an object to accelerate? 8. How are acceleration, time, and velocity	1. Constant Velocity Lab 2. Acceleration Lab 3. Graphing Motion Lab 4. Kinematics in the x direction test	

			drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **S11.C.3.1.3:** Describe the motion of an object using variables (i.e., acceleration, velocity, displacement).		related? 9. How can you calculate acceleration? 10. How do cops use motion in one dimension equations? 11. From looking at a velocity vs. time graphs, what conclusions can be drawn? 12. How can the motion of an object be described in a measurable and quantitative way horizontally?		
Weeks 8	Motion in One	**Patterns**	**S11.A.3.3:** Compare and	Acceleration describes	1. How can the motion of	1. Computer	

& 9.5	Dimension Vertically	**Exploration Analysis** Displacement Velocity Acceleration Due to Gravity	analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to make inferences and	how velocity of an object is changing with time.	an object be described in a measurable and quantitative way vertically? 2. How would vertical motion change if the setting were to change, for example the moon or the Sun? 3. How would one explain the procedure for sky diving with the theory of vertical acceleration and terminal velocity and the variables that must be accounted? 4. Describe how displacement, acceleration, and velocity are different in free-fall compared to horizontal motion.	Acceleration Freefall Lab 2. Dropping Objects Lab 3. Kinematics in the y direction test	

			predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **S11.C.3.1.3:** Describe the motion of an object using variables (i.e., acceleration, velocity, displacement).				
Weeks 9.5-11	Vector	**Analysis** Systems Vectors	**S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **M11.B.1:** Demonstrate an understanding of measurable attributes of objects and figures, and the units, systems and processes of measurement.	Vectors are a graphical representation of an objects properties or interactions with other objects in order for one to see the actions clearer.	1. How can one add vectors? 2. What is the difference between scalars and vectors? 3. Where are vectors used in everyday life?	1. Trig. Lab 2. Trig. Quiz 3. Vector Lab 4. Vector Test	
Weeks	Projectile	**Patterns**	**S11.A.3.1.1:** Apply	From studying projectile	1. How can the motion of	1. Projectile	

12 & 13	Motion	**Exploration Analysis** Vectors Systems Motion in two dimensions	systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **M11.B.1:** Demonstrate an understanding of measurable attributes of objects and figures, and the units, systems and processes of measurement. **S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables,	motion one can make predictions and calculations to better predict an objects location and magnitude.	an object be described in a measurable and quantitative way? 2. What are real life examples of projectile motion? 3. From projectile motion equations and theories, can one make predictions of dropping distances and range distances?	Motion Inquiry Lab 2. Projectile Motion Computer Lab 3. Angle vs. Range Lab 4. Speed vs. Range Lab 5. Projectile Motion Test	

			interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **S11.C.3.1.3:** Describe the motion of an object using variables (i.e., acceleration, velocity, displacement).				

Week 14	Relative Motion	**Patterns** **Vectors** **Analysis** Relative Motion	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to	Many objects are affected by others and/or perceived differently depending their position and time.	1. How does a person's frame of reference affect the perceived motion of an object? 2. How would one explain why it takes longer to fly west than it does to fly east in the US? 3. How does aeronautics and water deal with relative velocity?	1. Relative Motion Toy Car Lab 2. Relative Motion Quiz	

			make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **S11.C.3.1.3:** Describe the motion of an object using variables (i.e., acceleration, velocity, displacement).				
Week 15	Individualized Science Investigations	**Patterns** **Analysis** Proof Discovery Exploration	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g.,	All problems can all be investigated and solved if the proper procedure is followed.	1. What steps must one take in order to solve a problem effectively? 2. What does the data say from the findings? 3. How does your conclusion affect your thoughts prior to completing this lab? 4. What errors could have affected the experiment and how would these errors affect the results? 5. How does one perform an experiment that is unbiased and	1. Student Presentations	

			raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations.		accurate?		
Weeks	Forces	**Systems**	**S11.A.3.3:** Compare and	All forces arise from the	1. What is a force?	1. Feeling	

16, 17, & 18		**Patterns** **Exploration** **Analysis** Forces Vectors Friction	analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to make inferences and	interactions between different objects.	2. How are force and motion related? 3. How is the net force on an object determined? 4. Why is there friction between objects? 5. What is the difference between mass and weight? 6. What is inertia and how is it related to Newton's first law of motion? 7. How can Newton's second law be used to calculate and describe an object's acceleration? 8. According to Newton's third law of motion, how are the forces between interacting objects related? 9. How can one take a real life example such as a car crash and explain it using Newton's Laws of Motion? 10. How does Newton's second law explain the effects of air resistance? 11. Explain why friction is so important to everyday life? 12. How can one relate Newton's laws of motion to the motion	Forces Lab 2. Weight vs. Mass Lab 3. Newton's Laws Poster 4. Friction Lab 5. Force Test 6. Midterm-Cumulative (Same as Honors)	

			predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **S11.C.3.1.3:** Describe the motion of an object using variables (i.e., acceleration, velocity, displacement). **S11.A.3.3.3:** Analyze physical patterns of motion to make predictions or draw conclusions (e.g., solar system, tectonic plates, weather systems, atomic motion, and waves).		of the planets?		
Week 19 & 20	Work and Power	**Patterns** **Exploration** **Analysis** Work Simple Machines Power	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept	Machines have power and make doing work easier or faster by changing the force needed to do the work.	1. What is work? 2. How can work be calculated when force and motion are parallel to each other? 3. How do machines make work easier? 4. What is mechanical advantage and	1. Power and Power Stair lab 2. Power and Power Test	

			maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.3:** Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.C.3.1.2:** Design or evaluate simple technological or natural systems that incorporate the principles of force and motion (e.g., simple machines, compound machines).		efficiency? 5. What are some real life examples of simple and complex machines? 6. What does a machine power output tell you about that machine? 7. How can one design a machine to have more power but to do the same amount of work?		

			S11.C.3.1.5: Calculate the mechanical advantage for moving an object by using a simple machine. **S11.C.3.1.6:** Identify elements of simple machines in compound machines. **3.2.10.B2:** Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.				
Weeks 21 & 22	Energy	**Patterns** **Exploration** **Analysis** Kinetic Energy Potential Energy Law of Conservation of Energy	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures,	Energy can be transformed among its many forms, but energy cannot be created or destroyed.	1. What is the difference between kinetic energy and potential energy? 2. How can you calculate kinetic energy? 3. How can you calculate potential energy in all its forms? 4. What are the different forms of potential energy? 5. What is the law of conservation of energy? 6. What are some real life examples of the law of conservation of energy? 7. What is mechanical energy?	1. Conservation of Energy Lab 2. Toy Spring Lab 3. Energy Test 4. Roller Coaster Project	

			identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **3.2.10.B2:** Explain how the overall energy flowing through a system remains		8. Why is mechanical energy not always conserved? 9. How are power and energy related? 10. How can one use the law of conservation of energy to explain how a roller coaster works or any other real life examples?		

			constant. Describe the work-energy theorem.				
Weeks 23 & 24	Momentum	**Systems** **Patterns** **Exploration** **Analysis** Momentum Impulse Collisions Conservation of Momentum	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.	All forces arise from the interactions between different objects and all energy and momentum are transferred between the objects.	1. How does one determine an objects momentum? 2. Describe how an object can change its momentum? 3. How are momentum, energy, mass, and velocity all related? 4. By changing stopping distances and times, how does it affect the change in momentum and the impulse of that object? 5. How does force affect impulse? 6. How could one explain the conservation of momentum using a real life example? 7. What are the different types of collisions and how do these collisions differ? 8. What do all the collisions have in common? 9. How can cops use the law of conservation of momentum and energy to analyze different traffic conditions?	1. Momentum Lab 2. Impulse Egg Lab 3. Conservation of Momentum Lab 4. Momentum Test 5. Roller Coaster Project	

			S11.A.2.1.3: Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **S11.C.3.1.1:** Explain common phenomena (e.g., a rock in a landslide, an astronaut during a spacewalk, a car hitting a patch of ice on the road) using an understanding of conservation of momentum. **3.2.12.B2:** Explain how energy flowing through an open **system** can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict				

			and describe the motion of objects.				
Week 25 & 26	Roller Coaster Physics	**Systems Exploration** Energy Momentum Work Power Kinematics	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.	Physics is the reason we have roller coasters that are thrilling and exciting.	1. What features do all roller coasters need in order to become efficient and thrilling? 2. How can one calculate the speed, energy, power, work, and momentum of a roller coaster without being able to measure it physically? 3. When designing loops what does the designer need to focus on? 4. When making banking turns what must the designer look for? 5. What are some things a roller coaster designer must focus their attention to if they want a roller coaster that is efficient? 6. When a building model roller coaster, what are some features that are more difficult than other and why do they seem to challenge the student?	1. Roller Coaster Project	

			S11.A.2.1.3: Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **3.2.12.B2:** Explain how energy flowing through an open **system** can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.				
Week 27 &28	Circular Motion	**Systems** **Patterns** Centripetal Force Angular Speed Angular Displacement Universal Law of Gravitation	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g.,	All objects that move in a circular manor have some sort of force that manipulates it in order to maintain that motion including our planet.	1. How is circular motion related to linear motion? 2. What variables are related when it comes to linear kinematics and circular kinematics?	1. Centripetal Force Lab 2. Law of Gravitational Force Computer Lab 3. Angular	

		Kepler's Laws	flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the		3. Give a real life example of centripetal force? 4. Compare centripetal force to the fictitious force of centrifugal force? 5. What are some things that affect an objects ability to complete a circular motion? 6. What affects an object gravitational force? 7. What must an object have in order to have a gravitational force? 8. From the law of gravitation, what can be determined about a planet? 9. NASA uses the law of gravitation every day, what would they use this law for? 10. What do Kepler's laws tell us about our planetary motion? 11. How are Kepler's laws of motion and Netwon's laws of motion related?	Speed Computer Lab 4. Circular Motion Test	

			results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **3.2.12.B1:** Analyze the principles of rotational motion to solve problems relating to angular momentum and torque. **S11.D.3.1.1:** Describe planetary motion and the physical laws that explain planetary motion.				
Week 29	Torque	**Systems Explorations** Torque Simple Machines	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses,	All changes in rotational motion are due to torques.	1. How do we distinguish between force and torque? 2. How are torque, force, distance, and the angle all related to each other? 3. How does one calculate net Torque on an object? 4. What are the six simple machines? 5. How are torque and mechanical advantage related? 6. What is efficiency? 7. How could one design a complex machine using simple	1. Torque Lab 2. Rube Goldberg Project 3. Torque and Simple Machine Test	

			developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **3.2.12.B1:** Analyze the principles of		machines in order to create a machine that is efficient and complete a simple task, for example a Rube Goldberg Machine?		

			rotational motion to solve problems relating to angular momentum and torque. **S11.C.3.1.2:** Design or evaluate simple technological or natural systems that incorporate the principles of force and motion (e.g., simple machines, compound machines). **S11.C.3.1.5:** Calculate the mechanical advantage for moving an object by using a simple machine. **S11.C.3.1.6:** Identify elements of simple machines in compound machines.				
Week 30	Simple Harmonic Motion	**Systems Analysis Exploration** Simple Harmonic Motion Frequency Period	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the	In simple harmonic motion, restoring force is proportional to displacement and leads to the repetitive motion of objects such as a pendulum and a spring.	1. How does Hooke's law applied to the stretch of a spring? 2. What is the definition of simple harmonic motion and what is a real life example of simple harmonic motion? 3. Explain how frequency and period are related? 4. What variables affect the period of a pendulum?	1. Pendulum Lab 2. Simple Harmonic Motion Quiz	

			elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using		5. What would happen to a pendulum if it were located on some other planet? 6. Looking at amusement parks rides do the mass of the riders and the mass of the ride itself affect the ride? 7. What variables affect the period of a spring? 8. Is a spring affected by location the same way a pendulum is affected?		

			multiple representations. **3.2.P.B1:** Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects.				
Weeks 31 & 32	Waves	**Systems Analysis Exploration** Energy Transfer Longitudinal Waves Transverse Waves Parts of a Wave Speed Wave Behavior	**S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the	Waves are an energy transfer mechanism.	1. How do waves transfer energy? 2. What are mechanical waves? 3. How do transverse waves differ from longitudinal waves? 4. How are wavelength, frequency, and period related? 5. How can you calculate a speed of a wave? 6. Why would one need to know where the crest or trough of a wave is located? 7. What does the amplitude of the wave tell us about the wave? 8. What speed do radio, light, microwaves, ultraviolet, gamma rays, infrared waves,	1. Spring Wave Lab 2. Wave Test	

			problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **3.2.10.B5:** Understand that waves transfer energy without transferring matter **S11.A.3.3.3:** Analyze physical patterns of motion to make predictions or draw conclusions (e.g., solar system, tectonic plates, weather systems, atomic motion, and waves).		and x-rays travel at? 9. What is the law of reflection? 10. Why do waves change direction when they travel from material to another? 11. How are refraction and diffraction similar and different? 12. What happens when waves interfere with each other? 13. Give a real life example of refraction, reflection, diffraction, and interference?		

Weeks 32 & 33	Sound	**Systems Analysis Exploration** The Nature of Sound Properties of Sound Music Using Sound	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.	Sound waves carry energy that can be detected by the ear.	1. How does sound travel through different mediums? 2. What affects the speed of sound? 3. How does your ear enable you to hear? 4. How are amplitude, intensity, and loudness related? 5. How is sound intensity measured? 6. What is the relationship between frequency and pitch? 7. What is the Doppler Effect? 8. What real life examples provide a visual or auditory example of the Doppler Effect? 9. What is the difference between noise and music? 10. Why does a guitar sound different from a horn, even when both play the same note? 11. How doe string, wind, and percussion instruments produce music? 12. What are beats, and why do they occur? 13. If someone would want to make an	1. Sound Computer Lab 2. Doppler Effect Computer Lab 3. Sound Test	

			S11.A.2.1.3: Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **3.2.10.B5:** Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.		instrument, what would they need to know to be effective? 14. What are some of the factors that affect the design of concert halls and movie theaters? 15. How do some animals use sound waves to hunt and navigate? 16. How does sonar work? 17. How is ultrasound used in medicine?		
Weeks 35 & 36	Electromagnetic Spectrum & Light	**Systems Analysis Exploration** Electromagnetic Spectrum Wave Types Speed Frequency Wavelength	**S11.A.3.3:** Compare and analyze repeated processes or recurring elements in patterns. **S11.A.3.1.1:** Apply systems analysis, showing relationships (e.g., flowcharts, concept	Electromagnetic waves transfer energy through matter and through space, which is used in many modern devices. Light waves carry radiant energy.	1. How does a vibrating electric charge produce an electromagnetic wave? 2. What properties describe an electromagnetic wave?	1. Speed of Light Lab 2. Light Lab 3. Light and Electromagnetic Spectrum Test 4. Final-	

		Behavior of Light Color	maps), input and output, and measurements to explain a system and its parts. **S11.A.2.1.1:** Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design. **S11.A.2.1.2:** Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design. **S11.A.2.1.3:** Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits. **S11.A.2.1.4:** Critique the results and conclusions of		3. How do electromagnetic waves transfer energy? 4. What are the sub divisions of the electromagnetic spectrum? 5. What are the properties of each type of electromagnetic wave? 6. What are some common uses of each type of electromagnetic wave? 7. How are carrier waves modulated to transmit information? 8. What is the difference between amplitude modulation and frequency modulation? 9. What technologies use radio waves and microwaves fro communication? 10. How are transparent, translucent, and opaque materials different? 11. What is difference between regular and diffuse reflection? 12. What is the index of refraction of a	Cumulative Test(same as Honors)	

			scientific inquiry for consistency and logic. **S11.A.2.1.5:** Communicate results of investigations using multiple representations. **3.2.10.B5:** Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves. **3.2.12.B5:** Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission. **S11.C.2.1.1:** Compare or analyze waves in the electromagnetic spectrum (e.g., ultraviolet, infrared, visible light, X-rays, microwaves) as well as their properties, energy		material? 13. Why does a prism split white light into different components? 14. How do you see color? 15. What is the difference between light color and pigment color? 16. What happens when different colors are mixed? 17. How do different light bulbs work and what are the advantages and disadvantages of these different devices? 18. How does a laser produce coherent light? 19. What are some uses for lasers? 20. What is the difference between polarized and unpolarized light? 21. When does total internal reflection occur? 22. What are some real life examples of total internal reflection?		

			levels, and motion.				

***** Some teachers may need to think about the assessments and resources used in order to determine the Big Ideas, Enduring Understandings, and Essential Questions embedded in their courses. At this point in your curriculum mapping, you might want to ignore the "Common Assessments" and "Common Resources Used" columns. However, you may use them if you wish.