PHYSICS Curricular Documents

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Physics Course Information	
CURRICULUM/CONTENT AREA	**COURSE LENGTH**
Science	2 terms
GRADE LEVEL	**DATE LAST REVIEWED**
10-12	2016 Approved Curricular Docs 2023 Evaluation of Program
PREREQUISITE(s) ***if applicable***	**BOARD APPROVAL DATE**
NA	*December 2024*
PRIMARY RESOURCE ***if applicable***	
NA	

Desired Results	
COURSE DESCRIPTION	
In this course, students build fundamental concepts of physics by investigating intriguing phenomena that bridge classroom learning to how physics shapes the world around us. Through scientific inquiry, students develop skills in problem solving, analyzing evidence, using mathematics and computational thinking, and forming conclusions. Topics include forces & motion, relationships between energy & forces, wave properties, and electromagnetic radiation.	
ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Patterns: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them. **Cause and Effect:** Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. **Scale, Proportion, and Quantity:** In considering phenomena, it is critical	Unit 1- Sports & Competition: ➔ PS 2.A: How does an object keep moving once it starts? ➔ PS.2.A: Why do objects change their motion? ➔ PS 2.B: How do real world factors (friction and air resistance) affect an object's motion? Unit 2: Theme Park ➔ PS2B: How do objects interact with one another? ➔ PS2C: How do we prevent injury in collisions? ➔ PS3A&B: How do we exchange energy and momentum? Unit 3: Weather ➔ PS4A: How do the properties of waves affect the motion of the

to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.

Systems and Models: A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

Energy and Matter: Tracking energy and matter flows, into, and out of, and within systems helps one understand their system's behavior.

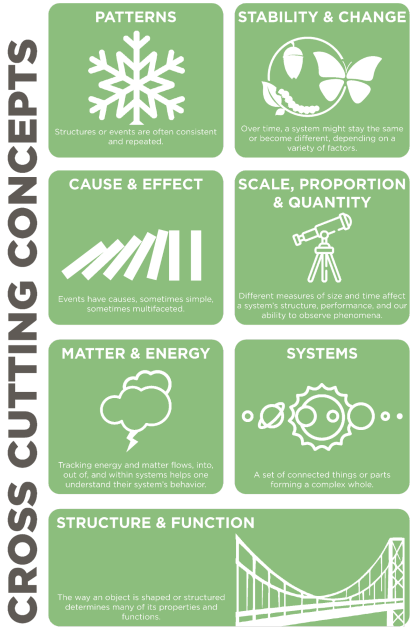
Structure and Function: The way an object is shaped or structured determines many of its properties and functions.

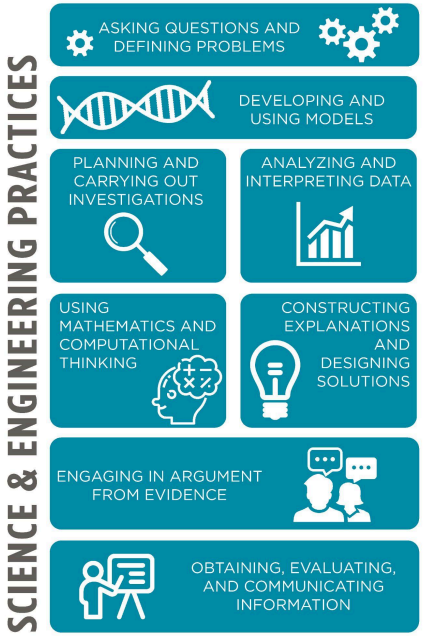
Stability and Change: For both designed and natural systems, conditions that affect stability and factors that control the rates of change are critical elements to consider and understand.

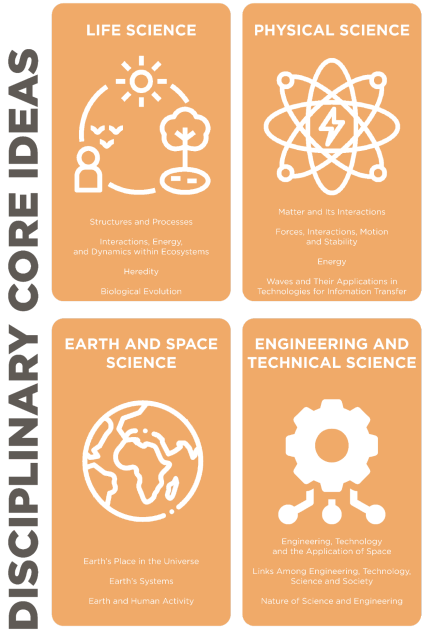
wave?

- ➔ PS4B: What are the similarities and differences between ocean, sound and light waves?
- ➔ PS4C: How do electromagnetic waves help us communicate?

3 Dimensional Standards







Standard SCI.CC1 - Patterns Students Observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale, thus requiring improved investigations and experiments. They use mathematical representations to identify and analyze patterns of performance in order to reengineer a designed system.	x	x	x
Standard SCI.CC2 - Cause and Effect Students understand empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.	x	x	x
Standard SCI.CC3 - Scale, Proportion, and Quantity Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. They use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).	x	x	x
Standard SCI.CC4 - Systems and System Models Students investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They also use models and simulations to predict the behavior of a system and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They also design systems to do specific tasks.	x	x	x
Standard SCI.CC5 - Energy and Matter Students understand that the total amount of energy and matter in closed systems is conserved. They describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.	x	x	x
Standard SCI.CC6 - Structure and Function Students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.	x	x	x
Standard SCI.CC7 - Stability and Change Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.	x	x	x

Science and Engineering Practices by GRADE BAND and UNIT	Unit 1	Unit 2	Unit 3
standard SCI.SEP1 - **A.Asking Questions** Students ask questions to formulate, refine, and evaluate empirically testable questions. This includes the following:	x	x	x

• Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and seek additional information. • Ask questions that arise from examining models or theories to clarify and seek additional information and relationships. • Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. • Ask questions to clarify and refine a model or an explanation • Evaluate a question to determine if it is testable and relevant. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. • Ask and evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of the design. **B.Defining Problems** Students formulate, refine, and evaluate design problems using models and simulations. This includes the following: • Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and environmental considerations. • Clarify and refine an engineering problem.			
Standard SCI.SEP2 - Developing and Using Models Students use, synthesize, and develop models to predict and show relationships among variables and between systems and their components in the natural and designed world. This includes the following: • Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria. • Design a test of a model to ascertain its reliability. • Develop, revise, and use models based on evidence to illustrate and predict the relationships between systems or between components of a system. • Develop and use multiple types of models to provide mechanistic accounts and predict phenomena. Move flexibly between these model types based on merits and limitations. Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and solve problems.	x	x	x
Standard SCI.SEP3 - Planning and Conducting Investigations Students plan and carry out investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models: This includes the following: • Individually and collaboratively plan an investigation or test a design to produce data that can serve as evidence to build and revise models, support explanations for phenomena, and refine solutions to problems. Consider possible variables or effects and evaluate the investigation's design to ensure variables are controlled. • Individually and collaboratively plan and conduct an investigation to produce data to serve as the basis for evidence. • In the design, decide on types, how much, and accuracy of data needed to produce reliable measurements. Consider limitations on the precision of the data (e.g., number of trials, cost, risk, time) and refine the design accordingly. • Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. • Select appropriate tools to collect, record, analyze, and evaluate data. • Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. • Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points, or to improve performance relative to criteria for success.	x	x	x
Standard SCI.SEP4 - Analyze and Interpret Data	x	x	x

Students engage in more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. This includes the following: • Analyze data using tools, technologies, and models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible. • Concepts should include determining the fit of functions, slope, and intercepts to data, along with correlation coefficients when the data is linear. • Consider and address more sophisticated limitations of data analysis (e.g., sample selection) when analyzing and interpreting data. • Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. • Evaluate the impact of new data on a working explanation or model of a proposed process or system. • Analyze data to optimize design features or characteristics of system components relative to criteria for success.			
Standard SCI.SEP5 - Mathematics and Computational Thinking Students use algebraic thinking and analysis, a range of linear and nonlinear functions (including trigonometric functions, exponentials, and logarithms), and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. This includes the following: • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. • Use mathematical, computational, and algorithmic representations of phenomena or design solutions to describe and support claims and explanations. • Apply techniques of algebra and functions to represent and solve scientific and engineering problems. • Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world. • Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, and others).	x	x	x
Standard SCI.SEP6 - **A.Construct Explanations** Students create explanations that are supported by multiple and independent student generated sources of evidence consistent with scientific ideas, principles, and theories. This includes the following: • Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources, including students' own investigations, models, theories, simulations, and peer review. • Explanations should reflect the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and evidence to provide an explanation of phenomena taking into account possible, unanticipated effects. • Apply scientific reasoning, theory, and models to link evidence to the claim and to assess the extent to which the reasoning and data support the explanation. B. **Design Solutions** Students create designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. This includes the following: • Design, evaluate, and refine a solution to a complex realworld problem, based on scientific knowledge, student-generated sources of evidence, and prioritized criteria. Consider tradeoffs. • Apply scientific ideas, principles, and evidence to solve design problems, taking into account possible unanticipated effects.	x	x	x

Standard SCI.SEP7 - Engage in Arguments Students use appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world. Arguments may also come from current scientific or historical episodes in science. This includes the following: • Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Respectfully provide and receive critiques on scientific arguments by probing reasoning and evidence, by challenging ideas and conclusions, by responding thoughtfully to diverse perspectives, and by determining what additional information is required to resolve contradictions. • Construct, use, and present oral and written arguments or counter-arguments based on data and evidence. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments. Consider relevant factors (e.g. economic, societal, environmental, and ethical considerations).	x	x	x
Standard SCI.SEP8 - Obtain, evaluate, and Communication Information Students evaluate the validity and reliability of claims, methods, and designs. This includes the following: • Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions, and to obtain scientific and technical information. • Summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • Compare, integrate, and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively, or text-based) in order to address a scientific question or solve a problem. • Gather, read, and evaluate scientific and technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. • Synthesize and evaluate the validity and reliability of multiple claims, methods, or designs that appear in scientific and technical texts or media reports. Verify the data when possible. • Communicate scientific and technical information in multiple formats, including orally, graphically, textually, and mathematically. Examples of information could include ideas about phenomena or the design and performance of a proposed process or system.	x	x	x

Disciplinary Core Ideas by GRADE BAND and UNIT			
PHYSICAL SCIENCE			
Standard SCI.PS2			
A. **FORCES AND MOTION:** Motion and changes in motion can be quantitatively described using concepts of speed, velocity, and acceleration (including speeding up, slowing down, and/or changing direction). Newton's second law of motion (F=ma) and the conservation of momentum can be used to predict changes in the motion of macroscopic objects. If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.	x	x	x

B. **TYPES OF INTERACTIONS:** Forces at a distance are explained by fields that can transfer energy and can be described in terms of the arrangement and properties of the interacting objects and the distance between them. These forces can be used to describe the relationship between electrical and magnetic fields. Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects	x	x	x
Standard SCI.PS3			
A. **DEFINITIONS OF ENERGY:** Systems move towards more stable states.		x	x
B. **CONSERVATION OF ENERGY AND ENERGY TRANSFER:** The total energy within a system is conserved. Energy transfer within and between systems can be described and predicted in terms of energy associated with the motion or configuration of particles (objects).		x	x
C. **RELATIONSHIPS BETWEEN ENERGY AND FORCES:** Fields contain energy that depends on the arrangement of the objects in the field.		x	x
Standard SCI.PS4			
A. **WAVE PROPERTIES:** The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. Waves can be used to transmit information and energy.			x
B. **ELECTRO-MAGNETIC RADIATION:** Both an electromagnetic wave model and a photon model explain features of electromagnetic radiation broadly and describe common applications of electromagnetic radiation			x
C. **INFORMATION TECHNOLOGIES AND INSTRUMENTATION:** Large amounts of information can be stored and shipped around as a result of being digitized.			x

Sports & Competition Phenomena

In this unit, students develop observations about motion and forces in sports and competition. Students develop models to represent constant velocity and accelerated motion pictorially, verbally, graphically, and computationally. These concepts are then extended into analyzing objects in freefall and projectile motion, both in a vacuum and in air resistance. Students develop and use free-body diagrams to represent the cause of acceleration in each of these cases. Newton's laws are investigated through collecting data and observations to discover the relationship between forces and the motion it can cause. Special attention is made to how frames of reference affect the perceived motion of an object or system.

SPORTS & COMPETITION DESIRED RESULTS

ESSENTIAL QUESTION:

- ➔ PS 2.A: How does an object keep moving once it starts?
- ➔ PS.2.A: Why do objects change their motion?
- ➔ PS 2.B: How do real world factors (friction and air resistance) affect an object's motion?

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
• **Standard SCI.CC1**: Students use science and engineering practices, disciplinary core ideas, and patterns to make sense of phenomena and solve problems. • **Standard SCI.CC2**: Students use science and engineering practices, disciplinary core ideas, and cause and effect relationships to make sense of phenomena and solve problems. • **Standard SCI.CC3**: Students use science and engineering practices, disciplinary core ideas, and an understanding of scale, proportion, and quantity to make sense of phenomena and solve problems. • **Standard SCI.CC4:** Students use science and engineering practices, disciplinary core ideas, and an understanding of systems and	➔ **Standard SCI.SEP1**: Students ask questions and define problems, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP2:** Students develop and use models, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP3**: Students plan and conduct investigations, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP4**: Students analyze and interpret data, in conjunction with using	**SCI.PS2.A: Forces and Motion** • (a) Motion and changes in motion can be quantitatively described using concepts of speed, velocity, and acceleration (including speeding up, slowing down, and/or changing direction). • (b) Newton's second law of motion (F=ma) and the conservation of momentum can be used to predict changes in the motion of macroscopic objects. **SCI.PS2.B: Types of Interactions** • Forces at a distance are explained by fields that can transfer energy and can be described in terms of the arrangement and properties of the interacting objects and the distance between them.

system models to make sense of phenomena and solve problems. • **Standard SCI.CC5**: Students use science and engineering practices, disciplinary core ideas, and an understanding of energy and matter to make sense of phenomena and solve problems. • **Standard SCI.CC6**: Students use science and engineering practices, disciplinary core ideas, and an understanding of structure and function to make sense of phenomena and solve problems. • **Standard SCI.CC7**: Students use science and engineering practices, disciplinary core ideas, and an understanding of stability and change to make sense of phenomena and solve problems.	crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP5**: Students use mathematics and computational thinking, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP6**: Students construct explanations and design solutions, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP7:** Students engage in argument from evidence, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP8:** Students obtain, evaluate, and communicate information, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.	

3 DIMENSIONAL LEARNING TARGETS

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

Extensions Learning Targets may include:

➔ In this unit, the central aim is to transcend basic learning targets by fostering deeper understanding, critical thinking, and creativity. Extensions and extra topics of spin on a ball, circular motion and forces on a car, 2 dimensional projectile calculations and 2 dimensional forces on the human body can be brought in to deepen understanding of the above learning target.

SPORTS & COMPETITION ASSESSMENT EVIDENCE

Performance is evaluated in terms of… Students will show their learning by…

Performance Task Description(s):

➔ PS 2.A: How does an object keep moving once it starts?
- ◆ HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

- SCI.PS2.A. (a) Motion and changes in motion can be quantitatively described using concepts of speed, velocity, and acceleration (including speeding up, slowing down, and/or changing direction).

➔ PS.2.A: Why do objects change their motion?
- HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
- SCI.PS2.A **(**b) Newton's second law of motion (F=ma) and the conservation of momentum can be used to predict changes in the motion of macroscopic objects.

➔ PS 2.B: How do real world factors (friction and air resistance) affect an object's motion?
- HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

Success Criteria Rubrics

➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback. (Rubric links- TBD)

Key Feedback & Assessment Strategies *(What are different ways students can demonstrate their learning?)**:***

- *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - *Driving Question Board to gather background knowledge and activate prior knowledge*
  - *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
  - *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
  - *Lab analysis questions and write-ups*
  - *Assess unit vocabulary terms*
  - *Evaluate student investigation tasks*
  - *Assess key unit concepts (Unit summative assessment)*

➔ *Extensions & College/Career Readiness may include:*
- All lessons: Remove scaffolds provided with Science and Engineering Practices as a way to give students more independent work with the elements of these practices.

The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

STAGE 3 Learning Plan: Sports & Competition Phenomena *Planned learning experiences and instruction: Learner Readiness, Key vocab, materials & resources unique to the unit*			
Plan & Prep for the Unit Stage:			
Review Learners' Attributes and needs: ● Review 504s & IEP at a Glance ● Review current classroom data (by standard) ● Review any ACT, screening, or diagnostic data ● Other?		Send Family Unit Communication ☐ *ADD example link*	Review any previous student exemplars Proficient ☐ *ADD LINK* Advanced/Excellent ☐ *ADD LINK*
Implementation Stage:			
Key Unit Vocabulary/ Root words:	Displacement, distance, speed, velocity, acceleration, freefall, forces, vector, scalar, system		
Days	**Daily Content**	**Differentiation, Accommodation and Extensions**	**Teacher Resources:**
Unit 1A: Constant Motion			

Day 1 - Constant Velocity	- *Anchoring phenomena*
	  - *Video - anchor*
	  - *Question Board*
	- *Speed of bubble lab*
	  - *Lab and discussion*
	  - *Intro CER*
		● Constant Velocity Buggy - Lab Doc, Pre-Lab, Post Lab Graphing Utility	●

Day 2 - Constant Velocity	- *Skateboarding phenomena demo*
	- *Motion Notes*
	  - ***Describing motion: Verbally, visually***
	  - *Distance vs. displacement*
	  - *(Link in different sports)*
	- *Relative motion*
	  - *Apple Watch Commercial*
			●

Day 3 - Constant Velocity	- *Graph Matching Lab* - *Graph Matching Game (online)*	Graphing Constant Motion Worksheet - Key	
Day 4 - Constant Velocity	- *Graphing motion problems*	Translating position time graphs to	

	- *Describing motion computationally* - *Speed and velocity* - *Notes and calculations*	velocity time graphs Worksheet - Key Equations and Graphs of Constant Motion Worksheet - Key	
Day 5 - Constant Velocity	- *Performance assessment* - *Constant velocity car crash*	Review Worksheet - Key	
Unit 1B: Accelerated Motion			

Day 6 - Constant Acceleration	- *Constant velocity vs. constant acceleration*
	  - *Skateboarder on a ramp video*
	  - *(video possibility - describing motion - focus on difference between flat part and inclines.)*
	- *Cart on a Ramp Lab*
		Cart on a Ramp Lab - Lab Doc, Pre-lab, Post Lab
		
		Cart on a Ramp Lab Extension - Lab Doc, Answer Key
			How to use lab quest:
			
			Setup and calibrate sensors
			
			Get rid of junk data
			
			Curve or linear fit only part of the graph
			
			Take the area under the curve on a graph
			
			Change graph types: x vs t into v vs t, etc

Day 7 - Constant Acceleration	- *Article - "Can our bodies handle the Hyperloop?"*
	  - *Connecting concepts to physics in article*
	- *Graph analysis -*
	  - *Stack-o-graphs (Conceptual)*
	  - *velocity time graph (numerical)*
		Numerical Graphs Worksheet - Key	

Day 8 - Constant Acceleration	- *Acceleration quiz (vocab focused)*
	- *Kinematic Equations*
	  - *Practice Problems*
	  - *Analyzing text and organizing problems to solve*
	  - *Connect problems to sports based questions...?*
		Kinematic Equations Worksheet - Key	Derivation of Kinematics Equations from Graphs video

Day 9 - Constant Acceleration	- *1 Question Quiz Kinematic Quiz* - *Review*		
Day 10 - Constant Acceleration	- *In class MC & Short answer on concepts and graphing* - *Short answer on a skateboarding data analysis*		

	- *Take home on problems*		
Day 11 - Freefall	- *Freefall Inquiry* - *Flying squirrel, feather and hammer on the moon, and flying squirrel suits videos*	Free Fall Lab - Doc, Pre-lab, Post Lab	

Day 12 - Freefall	- Freefall notes
	  - g=-9.8 m/s/s
	  - Real world factors
	- Freefall Article & Questions (LINK IN)
		Free Fall Worksheet (might be a little much at the end…) - Key	How to use the solver on a TI-84 Video

Day 13 - Freefall	- *1QQ Freefall* - *Review*	Simple 2D Motion Notes Simple 2D Worksheet - Key	
Day 14 - Freefall	- *Freefall Assessment* - *Science Journal: Constant & Accelerated Motion*		
Unit 1C: Forces			
Day 15 - Forces	- *Football phenomena video* - *Force Notes* - *Newton's Laws* - *Types of Forces*		
Day 16 - Forces	- *Concept Map - Motion & Forces* - *Focus on connecting concepts & linking in real world examples that can be connected to the anchoring phenomena or other examples* - *Force Diagrams*	Force Diagrams Notes Force Diagram Worksheet - Key	
Day 17 - Forces	- *Force Diagrams* - *Net Force & Newton's 2nd Law* -	Unbalanced Forces Simulation Unbalanced Forces Graphing Utility Unbalanced Forces Lab Document	
Day 18 - Forces	- *Force Diagram Quiz* - *Force and Motion: PhET Simulation*		
Day 19 - Forces	- *Friction Investigation* - *Shoes and different surfaces - connect in sports surfaces* - *Discuss Lab*	Friction Lab Extension Doc	

Day 20 - Forces	- *Friction Problems*		
Day 21 - Forces	- *Review*		
Day 22 - Forces	- *Forces Assessment* - *Science Journal - Forces*		

End of Unit Reflection:

- What successes did we have with students learning our desired results (Enduring Understandings, Essential Questions, Priority Standards)? How do we know? (summative results? Progress monitoring data?)
- What opportunities do we have to leverage desired results (Enduring Understandings, Essential Questions, Priority Standards, Anchor Phenomenon) in the future?
- How are we celebrating with students and as a team?

24/25	•
25/26	•
26/27	•
27/28	•

Theme Park Phenomena

This unit covers the concepts of energy and momentum conservation in theme park rides and games. Students develop models to represent energy and momentum pictorially, verbally, graphically, and computationally. Students will perform experiments to demonstrate the conservation of momentum and energy in a closed system. These concepts will be extended by having students analyze data from open systems to investigate work and impulse. Special attention will be paid to injury prevention in collisions. The concepts of momentum and energy will reinforce forces and kinematics phenomena.

THEME PARK DESIRED RESULTS

ESSENTIAL QUESTION:

- ➔ PS2B: How do objects interact with one another?
- ➔ PS2C: How do we prevent injury in collisions?
- ➔ PS3A&B: How do we exchange energy and momentum?

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
• **Standard SCI.CC1**: Students use science and engineering practices, disciplinary core ideas, and patterns to make sense of phenomena and solve problems. • **Standard SCI.CC2**: Students use science and engineering practices, disciplinary core ideas, and cause and effect relationships to make sense of phenomena and solve problems. • **Standard SCI.CC3**: Students use science and engineering practices, disciplinary core ideas, and an understanding of scale, proportion, and quantity to make sense of phenomena and solve problems. • **Standard SCI.CC4:** Students use science and engineering practices, disciplinary core ideas, and an understanding of systems and system models to make sense of phenomena and solve problems.	➔ **Standard SCI.SEP1**: Students ask questions and define problems, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP2:** Students develop and use models, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP3**: Students plan and conduct investigations, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP4**: Students analyze and interpret data, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and	**SCI.PS3.A: Definitions of Energy** • Systems move towards more stable states. SCI.PS3.B: Conservation of Energy and Energy Transfer • The total energy within a system is conserved. Energy transfer within and between systems can be described and predicted in terms of energy associated with the motion or configuration of particles (objects). **SCI.PS3.C: Relationships Between Energy and Forces** • Fields contain energy that depends on the arrangement of the objects in the field. **SCI.PS2.B: Types of Interactions** • Forces at a distance are explained by fields that can transfer energy and can be described in terms of the arrangement and properties of the interacting objects and the distance between them. **SCI.PS2.A: Forces and Motion**

• **Standard SCI.CC5**: Students use science and engineering practices, disciplinary core ideas, and an understanding of energy and matter to make sense of phenomena and solve problems. • **Standard SCI.CC6**: Students use science and engineering practices, disciplinary core ideas, and an understanding of structure and function to make sense of phenomena and solve problems. • **Standard SCI.CC7**: Students use science and engineering practices, disciplinary core ideas, and an understanding of stability and change to make sense of phenomena and solve problems.	solve problems. ➔ **Standard SCI.SEP5**: Students use mathematics and computational thinking, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP6**: Students construct explanations and design solutions, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP7:** Students engage in argument from evidence, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP8:** Students obtain, evaluate, and communicate information, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.	• (c) If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.

3 DIMENSIONAL LEARNING TARGETS

- ➔ HS-PS2-1. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
- ➔ HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
- ➔ HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
- ➔ HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Extensions Learning Targets may include:

- ➔ In this unit, the central aim is to transcend basic learning targets by fostering deeper understanding, critical thinking, and creativity. Extensions and extra topics of carnival scams highlighting multi dimensional collisions and energy dissipation that can be brought in to deepen understanding of the above learning targets.

THEME PARK ASSESSMENT EVIDENCE

Performance is evaluated in terms of… Students will show their learning by…

Performance Task Description(s):

- ➔ PS2B: How do objects interact with one another?
  - ◆ HS-PS2-1. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
  - ◆ HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
- ➔ PS2C: How do we prevent injury in collisions?
  - ◆ HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
- ➔ PS3A&B: How do we exchange energy and momentum?
  - ◆ HS-PS2-1. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
  - ◆ HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

Success Criteria Rubrics

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback. (Rubric links- TBD)

Key Feedback & Assessment Strategies *(What are different ways students can demonstrate their learning?)**:***

- ◆ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ◆ *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - *Driving Question Board to gather background knowledge and activate prior knowledge*
  - *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
  - *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
  - *Lab analysis questions and write-ups*
  - *Assess unit vocabulary terms*
  - *Evaluate student investigation tasks*
  - *Assess key unit concepts (Unit summative assessment)*
- ➔ *Extensions & College/Career Readiness may include:*
  - ◆ All lessons: Remove scaffolds provided with Science and Engineering Practices as a way to give students more independent work with the elements of these practices.

The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

STAGE 3 LEARNING PLAN: Theme Parks Phenomena *Planned learning experiences and instruction: Learner Readiness, Key vocab, materials & resources unique to the unit*		
Plan & Prep for the Unit Stage:		
Review Learners' Attributes and needs:	Send Family Unit Communication	Review any previous student

• Review 504s & IEP at a Glance • Review current classroom data (by standard) • Review any ACT, screening, or diagnostic data • Other?		☐ *ADD example link*	exemplars Proficient ☐ *ADD LINK* Advanced/Excellent ☐ *ADD LINK*
Implementation Stage:			
Key Unit Vocabulary/ Root words:	Momentum, impulse, energy (kinetic & potential), conservation of momentum, conservation of energy, elastic collisions, inelastic collisions, explosions, mechanical energy, elastic potential energy, kinetic energy, dissipated energy (thermal energy), gravitational potential energy, work, power		
	Daily Content	**Differentiation, Accommodations, and Extension**	**Teacher Resources:**
Unit 2A: Momentum			
Day 1 - Momentum	- *Anchoring Phenomena Video - bumper cars, carnival game, roller coaster* - *Momentum - Intro and Notes* - *Types of collisions*	Collisions Webquest - Key	•

Day 2 - Momentum	- *Momentum & Impulse*
	  - *Focus on Safety implications*
	  - *Connect to air bags, skiing airbags, and*
	- *Conservation of Momentum Simulation*
		Impulse Notes
		Collisions Worksheet - Key
			•

Day 3 - Momentum	- *Force and Motion Football Article (connecting back to Sports and Competition Unit)* - *Momentum Practice problems*		
Day 4 - Momentum	- *Review*	Momentum and Impulse Review - Key	
Day 5 - Momentum	- *Performance Assessment*		

	- *Conservation of Momentum Lab*		
Unit 2B: Energy			
Day 6 - Energy	- *Video phenomena - Roller coaster* - *Intro to Energy* - *Types & Evidence*	Intro to Energy Notes Energy Equations Notes	
Day 7 - Energy	- *Types & Evidence worksheet* - *Energy LOL's* - *Conservation of Energy Simulation*	LOLLL Diagrams Worksheet - Key	
Day 8 - Energy	- *Discuss Simulation* - *LOL Conservation of Energy* - *LOL Universe & More Activity*	Kinetic Energy Simulation Doc - Link	
Day 9 - Energy	- *Conservation of Energy LOL* - *Spring Lab*		
Day 10 - Energy	- *LOL Quiz* - *Elastic Energy Problems* - *Conservation of Energy Problems and Work*		
Day 11 - Energy	- *Conservation of Energy Lab*		
Day 12 - Energy	- *Conservation of Energy and Work Problems*		
Day 13 - Energy	- *Work, Energy, Power Lab*		
Day 14 - Energy	- *Conservation of Energy 1QQ* - *Take Home Celebration* - *Science Journal - Momentum and Energy*		
Day 15 - Energy	- *Review*		
Day 16 - Energy	- *Energy Assessment*	- Alternative Energy Project (Rio)	

Day 17 -18- Energy ** CAN BE MOVED EASILY!!	- *Marble Roller Coaster*		

End of Unit Reflection:

- What successes did we have with students learning our desired results (Enduring Understandings, Essential Questions, Priority Standards)? How do we know? (summative results? Progress monitoring data?)
- What opportunities do we have to leverage desired results (Enduring Understandings, Essential Questions, Priority Standards, Anchor Phenomenon) in the future?
- How are we celebrating with students and as a team?

24/25	•
25/26	•
26/27	•
27/28	•

Weather Phenomena

This unit covers the wave motion in mechanical waves, sound waves and electromagnetic waves in weather phenomena. Students will construct explanations about wave motion pictorially, verbally, graphically, and computationally. Students will apply various wave properties to electromagnetic and mechanical waves traveling in different media. These concepts extend into discussion on how waves help humans communicate and the dual nature of light. The concepts of wave motion will reinforce forces, kinematics, energy and momentum phenomena.

WEATHER DESIRED RESULTS

ESSENTIAL QUESTION:

- ➔ PS4A: How do the properties of waves affect the motion of the wave?
- ➔ PS4B: What are the similarities and differences between ocean, sound and light waves?
- ➔ PS4C: How do electromagnetic waves help us communicate?

UNIT PRIORITY STANDARDS: *Students will know and be able to…*

Cross Cutting Concepts	*Science & Engineering Practices (SEP)*	*Disciplinary Core Idea (DCI)*
• **Standard SCI.CC1**: Students use science and engineering practices, disciplinary core	➔ **Standard SCI.SEP1**: Students ask questions and define problems, in conjunction with	**SCI.PS4.A: Wave Properties**

ideas, and patterns to make sense of phenomena and solve problems. • **Standard SCI.CC2**: Students use science and engineering practices, disciplinary core ideas, and cause and effect relationships to make sense of phenomena and solve problems. • **Standard SCI.CC3**: Students use science and engineering practices, disciplinary core ideas, and an understanding of scale, proportion, and quantity to make sense of phenomena and solve problems. • **Standard SCI.CC4:** Students use science and engineering practices, disciplinary core ideas, and an understanding of systems and system models to make sense of phenomena and solve problems. • **Standard SCI.CC5**: Students use science and engineering practices, disciplinary core ideas, and an understanding of energy and matter to make sense of phenomena and solve problems. • **Standard SCI.CC6**: Students use science and engineering practices, disciplinary core ideas, and an understanding of structure and function to make sense of phenomena and solve problems. • **Standard SCI.CC7**: Students use science and engineering practices, disciplinary core ideas, and an understanding of stability and change to make sense of phenomena and solve problems.	using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP2:** Students develop and use models, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP3**: Students plan and conduct investigations, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP4**: Students analyze and interpret data, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP5**: Students use mathematics and computational thinking, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP6**: Students construct explanations and design solutions, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP7:** Students engage in argument from evidence, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems. ➔ **Standard SCI.SEP8:** Students obtain, evaluate, and communicate information, in conjunction with using crosscutting concepts and disciplinary core ideas, to make sense of phenomena and solve problems.	• The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. Waves can be used to transmit information and energy. **SCI.PS4.B: Electromagnetic Radiation** • Both an electromagnetic wave model and a photon model explain features of electromagnetic radiation broadly and describe common applications of electromagnetic radiation. **SCI.PS4.C: Information Technologies and Instrumentation** • Large amounts of information can be stored and shipped around as a result of being digitized.

3 DIMENSIONAL LEARNING TARGETS

- ➔ HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
- ➔ HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information.
- ➔ HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other
- ➔ HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
- ➔ HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
- ➔ HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

Extensions Learning Targets may include:

- ➔ In this unit, the central aim is to transcend basic learning targets by fostering deeper understanding, critical thinking, and creativity. Extensions and extra topics of solar flare effects on communications, astronomical redshift as well as gravitational lensing can be brought in to deepen understanding of the above learning targets.

WEATHER ASSESSMENT EVIDENCE

Performance is evaluated in terms of… Students will show their learning by…

Performance Task Description(s):

- ➔ PS4A: How do the properties of waves affect the motion of the wave?
  - ◆ HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
  - ◆ HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
- ➔ PS4B: What are the similarities and differences between ocean, sound and light waves?
  - ◆ HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other
  - ◆ HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
- ➔ PS4C: How do electromagnetic waves help us communicate?
  - ◆ HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information.
  - ◆ HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
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The above is not an exhaustive list but shows the possible strategies & tasks that provide meaningful student evidence of learning.

STAGE 3: UNIT LEARNING PLAN (under construction- note: this section does not require board approval) *Planned learning experiences and instruction: Learner Readiness, Key vocab, materials & resources unique to the unit*			
Plan & Prep for the Unit Stage:			
Review Learners' Attributes and needs: ● Review 504s & IEP at a Glance ● Review current classroom data (by standard) ● Review any ACT, screening, or diagnostic data ● Other?		Send Family Unit Communication ☐ *ADD example link*	Review any previous student exemplars Proficient ☐ *ADD LINK* Advanced/Excellent ☐ *ADD LINK*
Implementation Stage:			
Key Unit Vocabulary/ Root words:	Mechanical Waves, longitudinal, transverse, medium, amplitude, wavelength, period, frequency, speed of wave, crest, trough, speed of sound, electromagnetic waves, pressure, electromagnetic spectrum, intensity, compression, rarefaction		
	Daily Content	**Differentiation**	**Teacher Resources:**
Unit 3A: Waves			
Day 1 - Waves	- *Weather Phenomena Video* - *Wave Notes* - *Waves on a String Simulation*		● *Example- Africa Storyline Calendar w/key videos, data sets & activities*

Day 2 - Waves	- *Wave Characteristic Worksheet* - *Properties of Waves*		
Day 3 - Waves	- *Slinky Labs* - *Properties of waves, wave characteristics*		
Day 4 - Waves	- *Wave Calculations*		
Day 5 - Waves	- *Review*		
Day 6 - Waves	- *Wave Assessment*		
Unit 3B: Sound			
Day 7 - Sound	- *Phenomena Video* - *Sound Notes* - *Sound Demos*		
Day 8 - Sound	- *Speed of Sound Lab* - *Sound Calculations*		•
Day 9 - Sound	- *Sound Calculations* - *Review*		
Day 10 - Sound	- *Sound Assessment*		
Unit 3C: Light			
Day 10 - Light	- *Lightning Phenomena video* - *Light History & Theories Timeline*		
Day 11 - Light	- *Intro to Light Notes*		

Day 12 - Light	- *Light Stations*
	  - *Rarefaction*
	  - *Reflection*
	  - *Polarization*
	  - *Lenses*		

Day 13 - Light	- *Review*		

Day 14 - Light	- *Light Assessment*		

End of Unit Reflection:

- What successes did we have with students learning our desired results (Enduring Understandings, Essential Questions, Priority Standards)? How do we know? (summative results? Progress monitoring data?)
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