CCPS Science Unit Plan

Grade	10-12	**Subject**	Physics	**Unit #**	3
Unit Name	Momentum and Energy		**Timeline**	3 Weeks	
How to use the Framework	This Framework should be used to implement daily science instruction. The resources and instructional strategies reflected in the Framework will provide a foundation for effective implementation and student mastery of standards. Please see the hyperlinked abbreviation document to ensure understanding all abbreviations used with this framework.				
Unit Overview	In this unit, students will seek to answer the question "Why is energy important to humans and society?" The modules in this unit each provide part of the answer to this question. • **Module 9:** Students will learn about impulse, momentum, and the conservation of momentum, which will help them analyze collisions. • **Module 10:** Students will learn that energy comes in many forms, can be transferred or transformed, and is conserved, and that these properties allow humans to manipulate and use energy. • **Module 24:** Students will learn that atoms are made up of even smaller particles and the fundamental building blocks of the universe.				
Lesson Plan guidance document and template	CCPS Lesson Plan Template Day View Lesson Plan Template Week View Department of Science Guidance Document				

3Dimensional Instruction

GSE	Science and Engineering Practices	Crosscutting Concepts
SP3. Obtain, evaluate, and communicate information about the importance of conservation laws for mechanical energy and linear momentum in predicting the behavior of physical systems. a. Ask questions to compare and contrast open and closed systems. b. Use mathematics and computational thinking to analyze, evaluate, and apply the principle of conservation of energy and the Work-Kinetic Energy Theorem. • Calculate the kinetic energy of an object. • Calculate the amount of work performed by a force on an object. c. Plan and carry out an investigation demonstrating conservation and rate of transfer of energy (power) to solve problems involving closed systems. d. Construct an argument supported by evidence of the use of the principle of conservation of momentum to	**Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. **Using Mathematics and Computational Thinking** Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using 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	**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. **Systems and System 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, out of, and within systems helps one understand their system's behavior.

	• explain how the brief application of a force creates an impulse. • describe and perform calculations involving one dimensional momentum. • connect the concepts of Newton's 3rd law and impulse. • experimentally compare and contrast inelastic and elastic collisions. SP6. Obtain, evaluate, and communicate information about nuclear changes of matter and related technological applications. a. Develop and use models to explain, compare, and contrast nuclear processes including radioactive decay, fission, and fusion. b. Construct an argument to compare and contrast mechanisms and characteristics of radioactive decay. (Clarification statement: Include alpha, beta, and gamma decays and their effects.) c. Develop and use mathematical models and representations to calculate the amount of substance present after a given amount of time based on its half-life and relate this to the law of conservation of mass and energy	used based on mathematical models of basic assumptions. **Developing and Using Models** Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).	
NGSS Alignment	NGSS Alignment to Disciplinary Core Ideas		

Weekly Lesson Tasks

Week 1					
GSE: SP3.c.	**Focused Concept: Momentum and Its Conservation**				
Phenomenon: How do rockets accelerate once they reach space?			**DQ: What are the real world applications of Newton's Third Law?**		
SEP: Planning and Carrying Out Investigations, Using Mathematics and Computational Thinking			**CCC:** Cause & Effect, Systems & System Models		
	Day 1 9.1	**Day 2 9.2**	**Day 3 Lab**	**Day 4 CER**	**Day 5 10.1**
Learning Targets	**Students will explore impulse, momentum, and**	**Students will explore the conservation of**	**Students will explore collisions and**	**Students will culminate their learning about**	**Students will explore work, energy, and power,**

	how they are related by the impulse-momentum theorem. **<u>Focus Question:</u>** **How do airbags work to save lives?**	**momentum in a variety of situations, including collisions, recoil, and gyroscopes.** **<u>Focus Question:</u>** **What is recoil and how is it useful?**	**conservation as they perform an argument driven inquiry lab.**	**impulse, momentum, and the conservation of momentum, which help them analyze collisions.**	**and the relationship among them.** **<u>Focus Question:</u>** **What is energy?**
Opening (Teacher: The Lesson Resource can`be launched or assigned with Know/Want to Know Activity on digital textbook platform)	**• Show students the phenomenon card and/or embedded video** **• Use the See-Think-Wonder protocol to guide student thinking.** **• Teachers should provide students opportunities to share observations and develop questions. The teacher should record students' questions.**	**• Show students the phenomenon card and/or embedded video** **• Use the See-Think-Wonder protocol to guide student thinking.** **• Teachers should provide students opportunities to share observations and develop questions. The teacher should record students' questions.**	**• Show students the phenomenon card and/or embedded video** **• Use the See-Think-Wonder protocol to guide student thinking.** **• Teachers should provide students opportunities to share observations and develop questions. The teacher should record students' questions.**	**How do rockets accelerate once they reach space?** Engineering & Technology: Pushing Beyond Our Solar System TE Page 232 *Students will read, select and then research a particular propulsion technology *Students will develop a model to illustrate how the technology works. phenomenon card	**• Show students the phenomenon card and/or embedded video** **• Use the See-Think-Wonder protocol to guide student thinking.** **• Teachers should provide students opportunities to share observations and develop questions. The teacher should record students' questions.**
Guided Practice/ Transition TTW, provide 15-20 minutes of direct instructions. PPT presentations are available for every section of every chapter in the online textbook resources.	**The Teacher Will:** Use the teacher's presentation to support classroom instruction and spark discourse. Obtain data to inform your instruction by assigning the Impulse Momentum activity located in Lesson 1 in Module #9 in the interactive content online (The activity is referenced on page 214 in the text. Impulse and Momentum Presentation Explicitly instruct students	**The Teacher Will:** Use the Conservation of Momentum Presentation to support classroom instruction and spark discourse. Obtain data to inform your instruction by assigning the interactive content. Ask students if it is true that a system is restricted to a single object or body. Describe the Earth-Moon system and how it moves as a single system in orbit around the Sun, even	**The Teacher Will:** Review the purpose, underlying physics concepts and materials list for the ADI Lab 18. Elastic and Inelastic Collisions: Which Properties of a System Are Conserved During a Collision on pg 415. **Essential Vocabulary** *collision/collide	**The Teacher Will:** Go Further (pg. 234) Instructor will engage students in a data analysis lab: Pose the question - How does velocity change in an inelastic collision? Then analyze the data: 1. **Sketch** the before and after situations. 2. What is the players' velocity after the collision? 3. **Claim** - Does the	**The Teacher Will:** Instructor will: Facilitate student understanding of the readings (pg. 237) and use their journal to record evidence they collect as they complete the readings and activities in this lesson: **Essential Vocabulary** *work *joule *energy *work-energy theorem *kinetic energy *power

	(step by step) on how to use a math model and solve Sample problem on pg 216. **Essential Vocabulary** **impulse** **momentum** **impulse-momentum theorem** **angular momentum** **angular impulse** **angular momentum theorem**	though Earth and the Moon are not physically attached and move relative to each other. The Earth -Moon system is not an isolated system because of the role of the Sun. (TE pg. 223) **Essential Vocabulary** *closed system *isolated system *law of conservation of momentum *law of conservation of angular momentum		fullback score a touchdown? 4. **Evidence and Reasoning** -Justify your claim.	*watt
Independent Practice (TTW, circulate to monitor student performance and will clarify instructions as needed.)	**Student Will:** Practice Problems pg. 217. **TTW circulate to monitor student performance and will clarify instructions as needed.**	**Student Will:** **Cross Cutting Concept - Systems and System Models:** Examine Figure 11. How does the red ball in the photograph provide evidence for analyzing the system, and why is it necessary to help define the system? Suggest another way this could have been achieved, and make a model of the system to illustrate.	**Students will:** Complete the steps contained in the ADI #18. The teacher will facilitate the transition from one step to the next. **Students will make a plan, collect data, analyze data, and make a claim.** **TTW support students as they develop their plans for collecting and analyzing data.**	**Students Will:** CER - Explaining Your Reasoning: Revisit the claim you made when you encountered the phenomenon. Summarize the evidence you gathered from your investigations and research and finalize your summary Table. Does your evidence support your claim? If not, revise your claim. Explain why your evidence supports your claim.	**Students Will:** Activity Investigation (pg 237) Physics Lab: Stair Climbing and Power Analyze and interpret data to determine the relationships among force, power, and time. **Suggest this is homework:** Practice problems (pg 241)
Assessment Summary (Teachers should maximize the use of all the extended learning/assessment tasks if time permits.)	**TE Page 220-221** **Task:** Students will imagine a stuntman falling per the scenario presented and calculate the impulse from the Formative Assessment Check. **Extended:** >Progress Check Questions (Textbook or Online Science Notebook)	**TE Page 230-231** **Task:** Students will imagine two ice skaters colliding per the scenario presented and describe outcomes from the Formative Assessment Check. **Extended:** >Progress Check Questions (Textbook or	Task: Students will complete the ADI lab report.	**TE Page 234** **Task:** Access the online additional resources for a pre-made Chapter/Module Test to assign students. .	**TE Page 246-247** **Task:** Students will create a free-body diagram, identifying and calculating forces per the scenario from the Formative Assessment Check. **Extended:** >Progress Check Questions (Textbook or Online Science Notebook)

	>Access the online additional resources for a pre-made Lesson Check to assign students.	Online Science Notebook) >Access the online additional resources for a pre-made Lesson Check to assign students.			>Access the online additional resources for a pre-made Lesson Check to assign students.
Small Group Tasks (TBA)					

Week 2					
GSE: SP3.b.	**Focused Concept: Energy and Its Conservation**				
Phenomenon: How can energy from power plants be stored in the power grid for later use?			**DQ: What will the energy of the future be and how will it change the world?**		
SEP: Using Mathematics and Computational Thinking, Constructing Explanations and Designing Solutions			**CCC:** Patterns, Systems and System Models, Energy and Matter		
	Day 6 10.2	**Day 7 10.3**	**Day 8 10.4**	**Day 9 CER**	**Day 10 24.1**
Learning Targets	**Students will explore different forms of energy, with an emphasis on macroscopic kinetic energy and gravitational-potential energy.** **Focus Question:** **What are some forms of energy?**	**Students will explore the law of conservation of energy and use it to analyze collisions.** **Focus Question:** **Can energy be lost?**	**Students will explore the benefits of simple and compound machines.** **Focus Question:** **How do machines make tasks easier?**	**Students will culminate their learning that energy comes in many forms, can be transferred or transformed, and is conserved, and that these properties allow humans to manipulate and use energy.**	**Students will explore the structure of the nucleus, the forces acting on the particles within it, and the energy binding its particles together.** **Focus Question:** **What is inside an atom?**
Opening (Teacher: The Lesson Resource can`be launched or assigned with Know/Want to Know Activity on digital textbook platform)	**• Show students the phenomenon card and/or embedded video** **• Use the See-Think-Wonder protocol to guide student thinking.** **• Teachers should provide students opportunities to share observations and develop questions. The teacher should**	**• Show students the phenomenon card and/or embedded video** **• Use the See-Think-Wonder protocol to guide student thinking.** **• Teachers should provide students opportunities to share observations and develop questions. The teacher should**	**• Show students the phenomenon card and/or embedded video** **• Use the See-Think-Wonder protocol to guide student thinking.** **• Teachers should provide students opportunities to share observations and develop questions. The teacher should**	**Engineering & Technology** Greenhouse Gas Emission Efficiency: Excrement to Energy (Research & Summarize) TE Page 275 phenomenon card	**• Show students the phenomenon card and/or embedded video** **• Use the See-Think-Wonder protocol to guide student thinking.** **• Teachers should provide students opportunities to share observations and develop questions. The teacher should**

	record students' questions.	**record students' questions.**	**record students' questions.**		**record students' questions.**
Guided Practice/Transition TTW, provide 15-20 minutes of direct instructions. PPT presentations are available for every section of every chapter in the online textbook resources.	**The Teacher Will:** Engage students in the lesson by presenting the Many Forms of energy Presentation. Engage students by generating interests in raising questions and connecting past knowledge: The many forms of Energy Potential Energy - Practice Problems (pg. 254). **Essential Vocabulary** *translational kinetic energy *rotational kinetic energy *potential energy *gravitational potential energy *reference level *elastic potential energy *thermal energy	**The Teacher Will:** Conservation of energy Presentation: Instructor will engage students in: Get It? Explain Whether the light from the battery-powered lamp can have more energy than the battery's energy (pg. 257). Analyze how the ball's final kinetic energy in Figure 23 would be different if friction transformed some of the system's energy. Analyzed if most of the kinetic energy of a bouncing ball transforms into elastic potential energy, what happens to the rest of the kinetic energy? Optional 2: Go over Sample problem (pg 261) with students. **Essential Vocabulary** *law of conservation of energy *mechanical energy *elastic collision	**The Teacher Will:** Launch the Lesson: Machines Generates interest by raising questions and connecting to past knowledge. Demonstrate and instruct students on how to use the gizmo demo. **Essential Vocabulary** *machine *effort force *mechanical advantage *ideal mechanical advantage *efficiency *compound machine	**The Teacher Will:** Explain to students that one aspect of engineering is to solve existing problems. Many engineers work with technology that they hope will solve two problems–dealing with excess waste from farms, and producing clean energy. Guiding Questions: What are some different energy sources in which electricity is produced? What are some pros and cons of producing electricity from these different sources of energy? Students should describe a piece of technology that is used to generate or use a type of biofuel.	**The Teacher Will:** Use The Nucleus presentation to open the lesson and engage students in discussion on the anatomy of the atom. **The** Phet Simulation: Building an atom can be used as a prop in explaining the correlation between the composition of the atom and its position on the periodic table. The simulation is also a useful tool and taking the discussion further by using the tool to explain the octet rule and the formation of isotopes and Ions. **Essential Vocabulary** *nucleons *atomic number *mass number *atomic mass unit *strong nuclear force *mass defect *binding energy

		*inelastic collision			
Independent Practice (TTW, circulate to monitor student performance and will clarify instructions as needed.)	**Students Will:** Make a copy of the Student Exploration Sheet. They will use the Energy Conversion in a System Gizmo to navigate and complete the write up for the virtual lab. **TTW circulate to monitor student performance and will clarify instructions as needed.**	**Students Will:** Practice Problems (pg. 262). **TTW circulate to monitor student performance and will clarify instructions as needed.**	**Students Will:** Access Benefits of Machines online resource under the explore and explain. Students will read the six passages and answer the short answer questions for each of the 6 passages in paragraph form. **TTW circulate to monitor student performance and will clarify instructions as needed.**	**Students Will:** **How can energy from power plants be stored in the power grid for later use?** Revisit The Phenomenon (Claim, Evidence, Reasoning) TE Page 277 Students will create a CER based on the question and using information obtained from Days 5-8, present evidence and reasoning to support the claim. **GO Further** - (How much kinetic energy does a falling object have?) Students will complete a CER based on the scenario presented.	**The Student Will:** Complete Practice problems (pg 675) **TTW circulate to monitor student performance and will clarify instructions as needed.**
Assessment/Summary (Teachers should maximize the use of all the extended learning/assessment tasks if time permits.)	**TE Page 255-256** **Task:** Students will identify types of energy various systems possess based on examples from the Formative Assessment Check. **Extended:** >Progress Check Questions (Textbook or Online Science Notebook) >Access the online additional resources for a pre-made Lesson Check to assign students.	**TE Page 266** **Task:** Students will imagine walking on city streets per the scenario presented and show their displacement with vectors and a coordinate grid from the Formative Assessment Check. **Extended:** >Progress Check Questions (Textbook or Online Science Notebook) >Access the online additional resources for a pre-made Lesson Check to assign students.	**TE Page 274** **Task:** Students will be broken into groups of 4 and given a machine to "dissect" per the Formative Assessment Check. **Extended:** >Progress Check Questions (Textbook or Online Science Notebook) >Access the online additional resources for a pre-made Lesson Check to assign students.	**TE Page 277** **Task:** Access the online additional resources for a pre-made Chapter/Module Test to assign students.	**TE Page 678** **Task:** Students will answer and explain a binding energy question from the Formative Assessment Check. **Extended:** >Progress Check Questions (Textbook or Online Science Notebook) >Access the online additional resources for a pre-made Lesson Check to assign students.
Small Group Tasks (TBA)					

Week 3					
GSE: SP6.a., SP6.c.		**Focused Concept: Nuclear and Particle Physics**			
Phenomenon: How does the Sun produce energy and how can we replicate it?			**DQ:** Is nuclear energy the future?		
SEP: Developing and Using Models, Using Mathematics and Computational Thinking			**CCC:** Patterns, Cause & Effect, Energy and Matter		
	Day 11 24.2	**Day 12 24.3**	**Day 13 Review**	**Day 14 Test**	
Learning Targets	**Students will explore radioactive decay, fission, and fusion.** **Focus Question:** **How can nuclear reactions be useful?**	**Students will explore how scientists use particle accelerators and detectors to determine the fundamental make up of the universe.** **Focus Question:** **How do scientists discover particles they can't see?**	**Students will culminate their learning that atoms are made up of even small particles.**	**Students will be assessed on their knowledge of momentum, energy and nuclear physics.** **Focus Question:** **Why is energy important to humans and society?**	
Opening (Teacher: The Lesson Resource can`be launched or assigned with Know/Want to Know Activity on digital textbook platform)	**• Show students the phenomenon card and/or embedded video** **• Use the See-Think-Wonder protocol to guide student thinking.** **• Teachers should provide students opportunities to share observations and develop questions. The teacher should record students' questions.**	**• Show students the phenomenon card and/or embedded video** **• Use the See-Think-Wonder protocol to guide student thinking.** **• Teachers should provide students opportunities to share observations and develop questions. The teacher should record students' questions.**	**How does the Sun produce energy and how can we replicate it?** **Revisit The Phenomenon (Claim, Evidence, Reasoning) TE Page 703** **phenomenon card** **Students will create a CER based on the question and using information obtained from Days 10-12, present evidence and reasoning** to **support the claim.**	**Unit 3 Test**	
Guided Practice/Transition TTW, provide 15-20 minutes of direct instructions. PPT	**The Teacher Will:** Use Nuclear Decay and Reactions presentation to open the lesson and engage students in discussion on the anatomy of the atom.	**The Teacher Will:** Use Building Block of Matter presentation to open the lesson and engage students in discussion on the anatomy of the atom.	**The Teacher Will:** Select or create a set of review questions. (Kahoot, Quizizz, Blooket) **The Student Will:**	**Unit 3 Test**	

presentations are available for every section of every chapter in the online textbook resources.	Facilitate the use of mathematics and computational thinking to create a table of isotopes that provides information about all known isotopes of each element. It is an extended version of the periodic table. Ask students to use a table of isotopes to find the mass and percent abundance of the three naturally occurring isotopes of neon. **Essential Vocabulary** *radioactive *alpha decay *beta decay *gamma decay *nuclear reaction *half-life *activity *fission *chain reaction *fusion	Review practice problems from the previous nights homework. **Essential Vocabulary** *standard model *quarks *leptons *bosons *pair production *weak nuclear force	Participate using the platform selected by the teacher.		
Independent Practice (TTW, circulate to monitor student performance and will clarify instructions as needed.)	**The Students Will:** Go online and access the interactive content - Explore and Explain: Half Life. Students will use the passage to answer the short answer questions in paragraph form. Homework: Students will complete additional practice problems from pg 683.	**The students Will:** Play the Phet Simulation games which allows you to take turns selecting answers based on the information presented in each question. After player submits all their answers the simulation will give a score. Each student can play on their own chromebooks and compare results at the end of the simulation.	**Engineering & Technology: Fusion-A Future Energy Source?** Students will complete background reading task (Teacher can uses provided guided question). Students will develop a written argument about the importance of fusion as a future energy source per instructions provided. Page 701		
Assessment/Summary (Teachers should maximize the use of all the extended	**TE Page 688-689** **Task:** Students will hypothesize how the	**TE Page 700** **Task:** Students will present an argument as to	**TE Page 703** **Task:** Access the online additional resources for a	**Unit 3 Test**	

learning/assessment tasks if time permits.)	radium isotope is still found in nature per the scenario from the Formative Assessment Check. **Extended:** >Progress Check Questions (Textbook or Online Science Notebook) >Access the online additional resources for a pre-made Lesson Check to assign students.	distinguish protons (quarks) and electron (elementary particles) composition from the Formative Assessment Check. **Extended:** >Progress Check Questions (Textbook or Online Science Notebook) >Access the online additional resources for a pre-made Lesson Check to assign students.	pre-made Chapter/Module Test to assign students or customize your own.		[redacted]
Small Group Tasks (TBA)					

Assessment Prep
Prepare students for assessment by reviewing the following Assessment Prep concepts.

Labs / Investigations		
Mandatory Labs	**Explore Learning Gizmo**	**Pivot Interactives/Phet**
	Air Track **Crumple Zones** **2D Collisions** **Energy Conversions**	**PhET: Energy Skate Park Basics** **PhET: Atomic Interactions** **PhET: Isotopes and Atomic Mass** **PhET: Alpha Decay** **PhET: Beta Decay** **PhET: Nuclear Fission** **PhET: Radioactive Dating** **PhET: Nuclear Decay**

Additional Resources/Tasks	
Supplemental Resources	DRIVING QUESTIONS BOARD & SUMMARY TABLE (TE Page 210B) McGRAW ONLINE

	STEM UNIT PROJECT (TE Page 211) LEARNSMART **STEM Unit 3 Project**