Platte County
HOME OF THE PIRATES

SCIENCE CURRICULUM

PHYSICAL SCIENCE

Board Approval Date: pending
May 2024

PHYSICAL SCIENCE: UNIT 2 PROPERTIES OF MATTER

Overview

Quarter(s): 1st

Pacing: 4 Weeks

Unit Power Standard(s) Code	Unit Power Standard(s) Description
9-12.PS1.A1	USE the organization of the periodic table to PREDICT the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
9-12.PS1.A.2	CONSTRUCT and REVISE an explanation for the products of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
9-12.PS1.A.3	PLAN and CONDUCT an investigation to gather evidence to compare physical and chemical properties of substances such as melting point,boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive forces between particles.

Below Grade/Course Connected Standard(s)	Above Grade/Course Connected Standard(s)
8th grade 6-8.PS1.B.1 Develop and use a model to describe how the total number of atoms remains the same during a chemical reaction and thus mass is conserved. 6-8.PS1.A.1 Develop models to describe the atomic composition of simple molecules and extended structures.	Students who take Chemistry will also engage in 9-12.PS1.A.1, 9-12.PS1.A.2, and 9-12.PS1.A.3.

Unit Supporting Standards Code	Unit Supporting Standards Description
9-12.PS1.C.1	Use symbolic representations to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
9-12.PS1.A.5	Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
9-12.PS1.B.2	Refine the design of a chemical system by specifying a change in conditions that would alter the amount of products at equilibrium.

Unpacked Standard(s)

Power Standard(s) Code	Power Standard(s) Description	DOK(s)	DESE Expectation(s) Unwrapped

9-12.PS1.A1	Use the organization of the periodic table to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	3	**SCIENCE AND ENGINEERING PRACTICES** Developing and Using Models ● Use a model to predict the relationships between systems or between components of a system. **DISCIPLINARY CORE IDEAS** Structure and Properties of Matter ● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. **CROSSCUTTING CONCEPTS** Patterns ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
9-12.PS1.A.2	Construct and revise an explanation for the products of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	3	**SCIENCE AND ENGINEERING PRACTICES** Constructing Explanations and Designing Solutions ● 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) and the assumption that theories and laws that describe how the natural world operates today as they did in the past and will continue to do so in the future. **DISCIPLINARY CORE IDEAS** Structure and Properties of Matter ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.

			Chemical Reactions • The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. **CROSSCUTTING CONCEPTS** Patterns • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
9-12.PS1.A.3	Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive forces between particles.	3	**SCIENCE AND ENGINEERING PRACTICES** Planning and Carrying Out Investigations • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design, decide on types, quantity, 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. **DISCIPLINARY CORE IDEAS** Structure and Properties of Matter • The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. **CROSSCUTTING CONCEPTS** Patterns • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

DESE Questions Examples:

9-12.PS1.A1

Use the Periodic Table.

Match each statement with the proper classification.

	Metals	Nonmetals
sodium		
fluorine		
contains many gases		
conducts electricity in the solid state		
tends to lose electrons and form positive ions		

9-12.PS1.A.2

The following question has two parts. First, answer Part A. Then, answer Part B.

You may use the Periodic Table Reference Sheet to answer this question.

Part A

Sodium chloride, commonly known as table salt, is made of sodium (Na) ions and chloride (Cl) ions. Which of the following is the simplest formula unit for sodium chloride?

A. $NaCl$
B. Na_2Cl
C. $NaCl_2$
D. Na_3Cl_2

Part B

Enter the correct number into each box to complete the sentences.

This formula is best because a sodium atom has ☐ valence electron(s) and a chlorine atom has ☐ valence electron(s). Sodium forms an ion with a ☐ charge and chlorine forms an ion with a ☐ charge.

9-12.PS1.A.3

Physical science students conducted an investigation to compare the surface tension of three liquids. Some of the steps taken in the investigation were incorrect. Select the actions that made the investigation unsuccessful.

Select <u>all</u> that apply.

The students want to determine which liquid has the strongest surface tension by adding drops of three different liquids to the surface of a penny. Within a lab group, ○ <u>four students choose four different pennies to test</u> the different liquids. ○ <u>Two students decide to place their penny heads up and two students place their penny heads down</u>. They all decide to test water first. They use the ○ <u>same type of droppers to drop similar size drops onto the penny.</u> They find that they can drop an average of 44 drops of water onto the penny. Next they decide to test rubbing alcohol. They predict that they will not be able to get as many drops of rubbing alcohol on the penny ○ <u>because rubbing alcohol has weaker attractive forces than water.</u> They find that they are able to drop an average of 19 drops of rubbing alcohol on the penny. Finally, they test vegetable oil and predict it will have the least number of drops ○ <u>because oil is nonpolar and has the weakest attractive forces.</u> They find they are able to drop an average of 12 drops of oil before the oil runs over. They ○ <u>decide not to repeat the investigation</u>, as they have 4 pieces of data from their 4 different pennies.

"Unwrapped" Content (<u>nouns</u>) (students need to know)	"Unwrapped" Skills (VERBS) (students need to be able to do & DOK)	"Unwrapped" Understanding (students need to understand)
9-12.PS1.A1: periodic table properties elements patterns of electrons energy level atoms	Use Predict	Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.

9-12.PS1.A.2 products chemical reaction outermost electron atoms trends periodic table knowledge of patterns chemical properties	Construct Revise Explain	The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.
9-12.PS1.A.3 investigation evidence properties substances point forces particles.	Plan Conduct	The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.

New Academic Vocabulary	Scaffolded (Review) Academic Vocabulary
Relative properties of elements Trends in the periodic table Patterns of electrons (electron states) Outermost energy level Melting point Boiling point	Periodic table Explanation Products Chemical reaction Evidence Knowledge Properties Particles Forces Atoms Investigation Substances

Assessment

Common Summative Assessment/Demonstration of Understanding

- **Common Unit Assessment to be completed in the 2024-2025 School Year.**

Links to student example of summative assessments/demonstration of understanding

Score 4	Score 3	Score 2	Score 1
Example	**Example**	**Example**	**Example**

Proficiency Scale

4	**Student has mastered understanding of the entire standard(s) and makes little to no errors when asked to demonstrate and apply their learning.**
	•
3	**Student consistently shows understanding for most components of the standard(s) with few errors when asked to demonstrate and apply their learning.**
	•
2	**Student can sometimes show understanding for some of the components of the standard(s), yet there are a few aspects that they are still learning and improving upon.**
	•
1	**Student rarely shows understanding for any component of the standard(s) and are still needing significant teaching to apply their learning.**
	•

Additional Information

Professional Resource Suggestions	Instructional Resources
	Here are resources that are excellent for teachers and students: • Physics classroom (physicsclassroom.com). There are many resources for teachers and students: instructional websites, video tutorials that can be assigned, activities, simulations, etc. Although teachers and schools can pay for subscriptions (task tracker), many of these resources can be accessed for free. In terms of this document, teachers can search for different chemistry and physics topics. • Positive physics: This is a wonderful homework and quiz site. One needs to buy it to use it but all of the physical sciences concepts are presented in different units and teachers can use this for homework, in class practice, and quizzes. • Science buddies: great to find activities and projects • pHET - simulations and activities for students. Teachers can use lessons or do the sims with the students. • Edpuzzle resources (videos for students to watch and questions to answer) • POGIL (physics, chemistry, physical science) • Phenomena.app (short apps and physical processes to show students)

		Other Resources:
Curriculum Designer Notes:	○ 9-12.PS1.A1: ○ Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen. ○ 9-12.PS1.A.2: ○ Examples of chemical reactions could include the reaction of sodium and chlorine or of oxygen and hydrogen. Students will use the periodic table to create an explanation of how main group elements react, by identifying reactants and products. Students should know that noble gases do not usually react. ○ 9-12.PS1.A.3: ○ Emphasis is on understanding the relative strength of forces between particles. Examples of particles could include ions, atoms, molecules, and simple compounds (such as water).	

Physical Science: Unit 3 Chemical Bonding

Overview			
Quarter(s): 2nd			
Pacing: 7 - 8 Weeks			
Unit Power Standard(s) Code	**Unit Power Standard(s) Description**		
9-12.PS1.A.4	APPLY the concepts of bonding and crystalline/molecular structure to explain the macroscopic properties of various categories of structural materials (i.e., metals, ionic [ceramics], and polymers).		
9-12.PS1.B1	APPLY scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.		
9-12.PS1.B3	USE symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.		
Below Grade/Course Connected Standard(s)		**Above Grade/Course Connected Standard(s)**	
8th grade 6-8.PS1.B.1 Develop and use a model to describe how the total number of atoms remains the same during a chemical reaction and thus mass is conserved. 6-8.PS1.A.1 Develop models to describe the atomic composition of simple molecules and extended structures.		N/A	
Unit Supporting Standards Code	**Unit Supporting Standards Description**		
	No supporting standards applicable		

Unpacked Standard(s)			
Power Standard(s) Code	**Power Standard(s) Description**	**DOK(s)**	**DESE Expectation(s) Unwrapped**
9-12.PS1.A.4	Apply the concepts of bonding and crystalline/molecular structure to explain the	3	**SCIENCE AND ENGINEERING PRACTICES** Constructing Explanations and Designing Solutions • Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into

	macroscopic properties of various categories of structural materials (i.e. metals, ionic (ceramics), and polymers).		account possible unanticipated effects. **DISCIPLINARY CORE IDEAS** Structure and Properties of Matter ● In general, a substance will have certain macroscopic properties (i.e., conductivity, flexibility, shape) due to the types of bonds and arrangements between the atoms that make up the substance. Atoms that form ionic bonds typically have distinct characteristics (i.e., hard, soluble in water, high melting point, brittle, conductivity in solution) because of the lattice framework. Covalently bonded molecules have certain properties (i.e., low melting point, lower solubility, flexibility, ductility, malleability). **CROSSCUTTING CONCEPTS** Patterns ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
9-12.PS1.B3	Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	3	**SCIENCE AND ENGINEERING PRACTICES** Using Mathematics and Computational Thinking ● Use mathematical representations of phenomena to support claims. **DISCIPLINARY CORE IDEAS** Chemical Reactions ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. **CROSSCUTTING CONCEPTS** Energy and Matter ● The total amount of energy and matter in closed systems is conserved.
9-12.PS1.B1	Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature	3	**SCIENCE AND ENGINEERING PRACTICES** Constructing Explanations and Designing Solutions ● Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. **DISCIPLINARY CORE IDEAS** Chemical Reactions ●

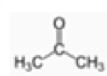
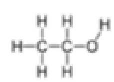
	or concentration of the reacting particles on the rate at which a reaction occurs.		Chemical processes, their rates, and whether energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. **CROSSCUTTING CONCEPTS** Patterns ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena

DESE Questions Examples:

9-12.PS1.A.4:

Sample Stems

A high school student dabbed three different cotton balls, each in a different liquid and wiped the table with the cotton ball. A second student timed how long it took for the liquid to evaporate. The students did a bit of research on the Internet and compiled their data and observations into the table below.

Substance	Molecule	Type of intermolecular force present	Relative strength of intermolecular force present	Relative rate of evaporation
Acetone		Dipole-dipole London dispersion	Medium	Very fast
Ethanol		Hydrogen bonding Dipole-dipole London dispersion	Medium-strong	Medium
Water		Hydrogen bonding Dipole-dipole London dispersion	Strong	Slow

1. What are some similarities and differences among the three substances listed?
2. How similar or different are the objects on the microscopic scale?
3. What does the pattern of data you see allow you to conclude from the test of the substances?

9-12.PS1.B3:

Sample Stems Sodium Oxide (Na2 O) can react with hydrochloric acid(HCl) to produce sodium chloride (NaCl) and water (H2 O) according to the following equation: Na2 O + 2HCl -> 2NaCl + H2 O 1. Part A:Identify the total atoms present before and after the reaction? Part B:Describe the relationship between the number of atoms before and after the reaction. A group of students in the lab reacts sodium oxide (Na2 O) with hydrochloric acid (HCl) to produce sodium chloride (NaCl) and water (H2 O). When writing their lab report, they came up with the following equation to represent the reaction: Na2O + HCl -> NaCl + H2 O 2. Part A: Does this equation satisfy the Law of Conservation Of Matter? Part B:Use the model to explain why or why not?

Sample Stems

Sodium Oxide (Na_2O) can react with hydrochloric acid (HCl) to produce sodium chloride (NaCl) and water (H_2O) according to the following equation:

$$Na_2O + 2HCl \rightarrow 2NaCl + H_2O$$

1. **Part A:** Identify the total atoms present before and after the reaction?
   Part B: Describe the relationship between the number of atoms before and after the reaction.

A group of students in the lab reacts sodium oxide (Na_2O) with hydrochloric acid (HCl) to produce sodium chloride (NaCl) and water (H_2O). When writing their lab report, they came up with the following equation to represent the reaction:

$$Na_2O + HCl \rightarrow NaCl + H_2O$$

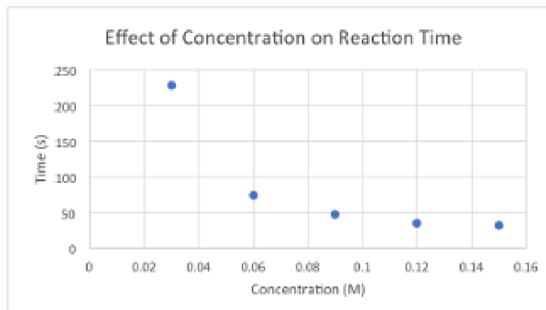
2. **Part A:** Does this equation satisfy the Law of Conservation of Matter?
   Part B: Use the model to explain why or why not?

9-12.PS1.B1:

Sample Stems

The graph below depicts a chemical reaction between substance X and Y. The reaction is X + Y -> XY

1. What pattern do you observe in the data presented in the graph?
2. Develop a model which explains what might be going on we cannot see. It is fine to represent X as a circle and Y as a square.



"Unwrapped" Content (<u>nouns</u>) (students need to know)	"Unwrapped" Skills (VERBS) (students need to be able to do & DOK)	"Unwrapped" Understanding (students need to understand)
9-12.PS1.A.4: Nouns: concepts structure macroscopic properties categories materials (i.e. metals, ionic (ceramics), and polymers)	Apply Explain	Structure and Properties of Matter: In general, a substance will have certain macroscopic properties (i.e., conductivity, flexibility, shape) due to the types of bonds and arrangements between the atoms that make up the substance. Atoms that form ionic bonds typically have distinct characteristics (i.e., hard, soluble in water, high melting point, brittle, conductivity in solution) because of the lattice framework. Covalently bonded molecules have certain properties (i.e., low melting point, lower

		solubility, flexibility, ductility, malleability)
9-12.PS1.B3: representations calculations claim atoms mass chemical reaction	Use Support Conserve	Chemical Reactions: The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
9-12.PS1.B1: principles evidence explanation effects temperature concentration reacting particles rate reaction	apply provide change	Chemical Reactions Chemical processes, their rates, and whether energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.

New Academic Vocabulary	Scaffolded (Review) Academic Vocabulary
Crystalline/molecular structure Polymer Ceramics Rate of reaction	Bonding Properties Structure Materials Metals ionic Principles Evidence Temperature Concentration Reaction Representations Calculations Mass Atoms Particles

Assessment

Common Summative Assessment/Demonstration of Understanding
• **Common Unit Assessment to be completed in the 2024-2025 School Year.**
Links to student example of summative assessments/demonstration of understanding

Score 4	Score 3	Score 2	Score 1
Example	Example	Example	Example

Proficiency Scale

4	**Student has mastered understanding of the entire standard(s) and makes little to no errors when asked to demonstrate and apply their learning.**
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	•

Additional Information

Professional Resource Suggestions	Instructional Resources
	Here are resources that are excellent for teachers and students: • Physics classroom (physicsclassroom.com). There are many resources for teachers and students: instructional websites, video tutorials that can be assigned, activities, simulations, etc. Although teachers and schools can pay for subscriptions (task tracker), many of these resources can be accessed for free. In terms of this document, teachers can search for different chemistry and physics topics. • Positive physics: This is a wonderful homework and quiz site. One needs to buy it to use it but all of the physical sciences concepts are presented in different units and teachers can use this for homework, in class practice, and quizzes. • Science buddies: great to find activities and projects • pHET - simulations and activities for students. Teachers can use lessons or do the sims with the students. • Edpuzzle resources (videos for students to watch and questions to

	answer) ● POGIL (physics, chemistry, physical science) ● Phenomena.app (short apps and physical processes to show students)
	Other Resources:
Curriculum Designer Notes:	○ 9-12.PS1.A.4: ○ Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors. Students will be able to explain the properties of a substance based on its crystalline/molecular structure. ○ 9-12.PS1.B3: ○ Emphasis is on conservation of matter and mass through balanced chemical equations, use of the mole concept and proportional relationships. Students will be able to demonstrate that the number of products equals the number of reactants. ○ 9-12.PS1.B1: ○ Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules. Increasing the temperature increases the kinetic energy of particles. Increasing the number of reactants increases the number of collisions, which increases the reaction rate. Students will analyze data of reaction rates and explain how temperature or concentration affects the rate of reaction.

Physical Science: Unit 4 Force and Motion

Overview	
Quarter(s): 3rd	
Pacing: 4 - 5 Weeks	
Unit Power Standard(s) Code	**Unit Power Standard(s) Description**
9-12.PS2.A.1	ANALYZE data to support and verify the concepts expressed by Newton's 2nd law of motion, as it describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
9-12.PS2.A.3	APPLY scientific principles of motion and momentum to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
9-12.PS2.B.1	USE mathematical representations of Newton's law of gravitation to describe and predict the gravitational forces between objects.

Below Grade/Course Connected Standard(s)	Above Grade/Course Connected Standard(s)
7th grade 6-8.PS2.A.1: Apply physics principles to design a solution that minimizes the forces of an object during a collision and develop an evaluation of the solution. 6-8.PS2.B.3: Conduct an investigation and evaluate the experimental design to provide evidence that electric and magnetic fields exist between objects exerting forces on each other even though the objects are not in contact.	N/A

Unit Supporting Standards Code	Unit Supporting Standards Description
9-12.PS2.B.2	Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
9-12.PS2.A.2	Use mathematical representations to support and verify the concepts that the total momentum of a system of objects is conserved when there is no net force on the system.

Unpacked Standard(s)

Power Standard(s) Code	Power Standard(s) Description	DOK(s)	DESE Expectation(s) Unwrapped
9-12.PS2.A.1	Analyze data to support and verify the concepts expressed by	3	Clarification statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a

	Newton's 2nd law of motion, as it describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.		falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. Students can analyze diagrams with different variables to support relationships among mass, acceleration, and force. **SCIENCE AND ENGINEERING PRACTICES** Analyzing and Interpreting Data ● Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. **DISCIPLINARY CORE IDEAS** Forces and Motion ● Newton's second law accurately predicts changes in the motion of macroscopic objects. **CROSSCUTTING CONCEPTS** Cause and Effect ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
9-12.PS2.A.3	Apply scientific principles of motion and momentum to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.	3	**SCIENCE AND ENGINEERING PRACTICES** Constructing Explanations and Designing Solutions ● Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. **DISCIPLINARY CORE IDEAS** Forces and Motion ● 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. **CROSSCUTTING CONCEPT**S Cause and Effect ● Systems can be designed to cause a desired effect
9-12.PS2.B.1	Use mathematical representa-tions of Newton's law of gravitation to describe and predict the gravitational forces between objects.	3	**SCIENCE AND ENGINEERING PRACTICES** Using Mathematics and Computational Thinking ● Use mathematical representations of phenomena to describe explanations. **DISCIPLINARY CORE IDEAS** Types of Interactions ● Newton's law of universal gravitation provides the mathematical models to describe and predict the effects of gravitational forces between distant objects. ● Forces at a distance are explained by fields (i.e., gravitational, electric, magnetic) permeating space that can transfer energy through space. **CROSSCUTTING CONCEPTS** Patterns ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

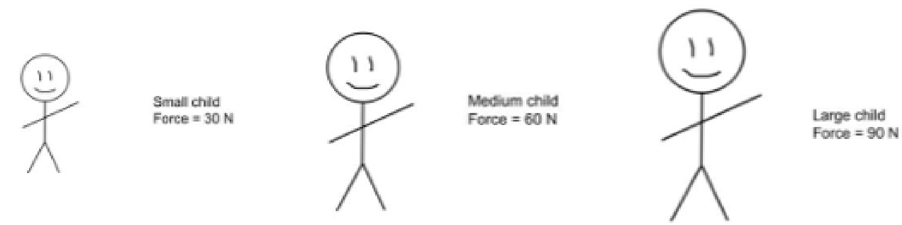
DESE Questions Examples:

9-12.PS2.A.1:

Sample Stems

Five children were at the park one summer afternoon. The children decided to play a game of tug of war. Using Figure 1 where we assume that the model of each child's size and force is correct for each child.

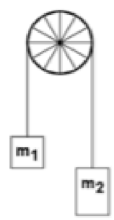
Figure 1. Sizes of Children Playing Tug of War



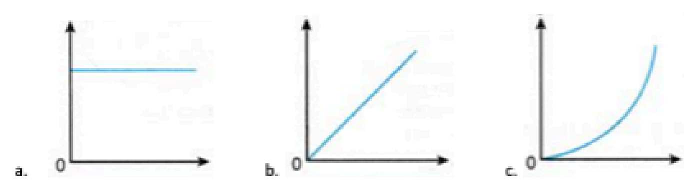
1. **Part A:** identify the configuration of five children total that would allow for a fair game (net force = 0) of tug of war.
   Part B: Draw a picture of the configuration including vectors of forces.

Assume both weights are at the same distance from the ground (from the bottom of the weight) and the pulley provides no friction.

m1 = 50 grams
m2 = 100 grams



1. **Part A:** Draw a diagram using force vectors to show the direction the weights move.
   Part B: Using F = ma, mathematically support the net force direction shown in Part A. (use a = 10 m/s/s)
2. **Part A:** Which of the following graphs best show how the object which falls downward changes speed as it falls to the ground?



d. None of these

Part B: Explain the reasoning for your answer to Part A.

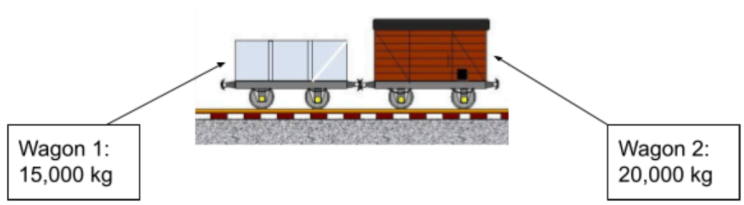
9-12.PS2.A.2:
Sample Stems
Two cars are involved in a head-on collision in an alley. The driver of a car with mass, ma = 1,200 kg claims to have been traveling west at via = 7 m/s. The driver of the other car with mass, mb = 1,000 kg claims to have been traveling east at vib = 10 m/s. The investigating officer found that both cars were stuck together and traveled with a common final velocity of 3 m/s, eastward, after the collision.
1. Draw pictures to show the following points in time. The pictures should bring out how the parts of the system described in the scenario act.
Part A: Before.
Part B: During the collision.
Part C: After.
2. Use mathematics, describe why the two cars attached to one another moved

at 3 m/s eastward after the collision.

3. Part A: Using the law of conservation of momentum, what conclusions can the officer make about the accident?

Part B: What conditions would have to change for the officer to make a different claim?

Consider two railway wagons that are buffered up very tightly and the springs in the buffers are ready to push them apart (as seen in the picture). When the wagons are released, they fly apart in opposite directions.



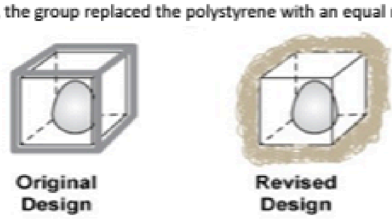
The brakes on the wagons are released at the same time. The release of the springs makes Wagon 2 move to the right at a velocity of 0.10 m/s.

1. Determine the velocity (v = d/t) of Wagon 1.

9-12.PS2.A.3:

Sample Stems

A group of students must design an egg-carrying device that will prevent a raw egg from breaking when it is dropped from a two-story window. The model above shows one group's design. The group's original design used hard polystyrene to cover the exterior of the device. At the last minute, the group replaced the polystyrene with an equal mass of crumpled grocery bag paper.



1. Use evidence to describe why replacing the polystyrene with crumpled paper helped to minimize the force of the impact on the egg.

In order to keep drivers and passengers safe in automobile crashes, new designs are being implemented all the time. Crumple zones are just one area that scientists and engineers are trying to improve to keep people safe in collisions. Crumple zones accomplish this by creating a buffer zone around the perimeter of the car. Certain parts of a car are inherently rigid and resistant to deforming, such as the passenger compartment and the engine. If those rigid parts hit something, they will decelerate very quickly. Surrounding those parts with crumple zones allows the less rigid materials to take the initial impact. The car begins decelerating as soon as the crumple zone starts crumpling, extending the deceleration over a few extra tenths of a second.

1. Use evidence to explain how improving the crumple zone and, consequently, the time of deceleration helped to keep people safer in collisions?

9-12.PS2.B.1:

Sample Stems

Scientists have discovered a new planet with three moons orbiting around it. The mass of the planet is 200 units. The masses of the moons and their distance from the planet are given in the table below.

Orbiting Moons

Moon Name	Moon Mass	Distance from Planet
Balerion	10	5
Meraxes	5	2
Vhagar	3	3

1. Using information from the stimulus and table answer Parts A-C.
   Part A: Draw a model of the planet and three-moon system. Be sure to label all parts of the model with distances and masses.
   Part B: Using your model from Part A make a prediction that ranks the gravitational force between the planet and the moons from greatest to least.
   Part C: Using the mathematical equation, $F_g = G\frac{m_1 m_2}{d^2}$, compute the force between each planet and moon.
   Part D: Compare your answer to Part B and Part C. Describe any similarities or differences between the two.

"Unwrapped" Content (nouns) (students need to know)	"Unwrapped" Skills (VERBS) (students need to be able to do & DOK)	"Unwrapped" Understanding (students need to understand)
9-12.PS2.A.1: Data, concepts, Newton's 2nd Law, relationship, net force, object, mass, acceleration	Analyze, support, verify, describes	Newton's second law accurately predicts changes in the motion of macroscopic objects.
9-12.PS2.A.3: Principles, motion, momentum, force, object, collision	Apply, design, evaluation, refine, minimizes	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.
9-12.PS2.B.1: representations , law of gravitation, gravitational forces, objects	Use, describe, predict	● Newton's law of universal gravitation provides the mathematical models to describe and predict the effects of gravitational forces between distant objects. ● Forces at a distance are explained by fields (i.e., gravitational, electric, magnetic) permeating space that can transfer energy through space.

New Academic Vocabulary	Scaffolded (Review) Academic Vocabulary
momentum collision law of gravitation gravitational forces net force conservation	data concept relationship object principles motion force(s) Representations Mass Acceleration Newton's second law Law

Assessment

Common Summative Assessment/Demonstration of Understanding

- **Common Unit Assessment to be completed in the 2024-2025 School Year.**

Links to student example of summative assessments/demonstration of understanding

Score 4	Score 3	Score 2	Score 1
Example	Example	Example	Example

Proficiency Scale

4	**Student has mastered understanding of the entire standard(s) and makes little to no errors when asked to demonstrate and apply their learning.** •
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Additional Information

Professional Resource Suggestions	Instructional Resources
	Here are resources that are excellent for teachers and students: • Physics classroom (physicsclassroom.com). There are many resources for teachers and students: instructional websites, video tutorials that can be assigned,

	activities, simulations, etc. Although teachers and schools can pay for subscriptions (task tracker), many of these resources can be accessed for free. In terms of this document, teachers can search for different chemistry and physics topics. ● Positive physics: This is a wonderful homework and quiz site. One needs to buy it to use it but all of the physical sciences concepts are presented in different units and teachers can use this for homework, in class practice, and quizzes. ● Science buddies: great to find activities and projects ● pHET - simulations and activities for students. Teachers can use lessons or do the sims with the students. ● Edpuzzle resources (videos for students to watch and questions to answer) ● POGIL (physics, chemistry, physical science) ● Phenomena.app (short apps and physical processes to show students)
	Other Resources:
Curriculum Designer Notes:	○ 9-12.PS2.A.3: ○ Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute. Students can defend an argument using prior knowledge of the relationship between force and momentum. ○ 9-12.PS2.B.1: ○ Emphasis is on both quantitative and conceptual descriptions of gravitational fields. Students can predict the gravitational force of an object based on a given ratio of mass to gravity.

Science: Unit 5 Energy

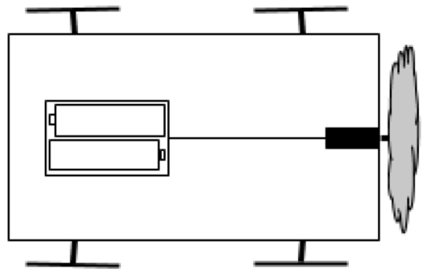
Overview			
Quarter(s): 3rd and 4th			
Pacing: 4 - 5 Weeks			
Unit Power Standard(s) Code	**Unit Power Standard(s) Description**		
9-12.PS3.A2	DEVELOP and USE models to ILLUSTRATE that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).		
9-12.PS3.A3	DESIGN, BUILD, and REFINE a device that works within given constraints to CONVERT one form of energy into another form of energy.		
9-12.PS3.B1	PLAN and CONDUCT an investigation to PROVIDE evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy.		
Below Grade/Course Connected Standard(s)		**Above Grade/Course Connected Standard(s)**	
7th grade 6-8.PS3.A.4 Plan and conduct an investigation to determine the relationship among energy transferred, the type of matter, the mass, and the change in temperature of the sample.		N/A	
Unit Supporting Standards Code	**Unit Supporting Standards Description**		
9-12.PS3.A1	Create a computational model to calculate the change in the energy of one component in a system when the changes in energy are known.		
9-12.PS3.C1	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction		

Unpacked Standard(s)			
Power Standard(s) Code	**Power Standard(s) Description**	**DOK(s)**	**DESE Expectation(s) Unwrapped**
9-12.PS3.A2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of	3	**Clarification Statement** - Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.

	energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).		**SCIENCE AND ENGINEERING PRACTICES** Developing and Using Models ● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a System. **DISCIPLINARY CORE IDEAS** Definitions of Energy ● Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that it is continually transferred from one object to another and between its various possible forms. At the macroscopic scale, energy manifests itself in multiple ways such as in motion, sound, light, and thermal energy. ● These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases, the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. **CROSSCUTTING CONCEPTS** Energy and Matter ● Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems.
9-12.PS3.A3	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	3	**Clarification Statement** - Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use. **SCIENCE AND ENGINEERING PRACTICES** Constructing Explanations and Designing Solutions ● Design, evaluate, and/or refine a solution to a complex real-world problem based on

			scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations. **DISCIPLINARY CORE IDEAS** Definitions of Energy ● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.Energy in Chemical Processes ● Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. Defining and Delimiting an Engineering Problem ● Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
9-12.PS3.B1	Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). Expectation	3	**Clarification Statement:** Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water. **SCIENCE AND ENGINEERING PRACTICES** Planning and Carrying Out Investigations ● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design, decide on types, quantity, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. **DISCIPLINARY CORE IDEAS** Conservation of Energy and Energy Transfer ● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.

			• Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). Energy in Chemical Processes • Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. **CROSSCUTTING CONCEPTS** Systems and System Models • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.
DESE Questions Examples:	9-12.PS3.A2 **Sample Stems** **A 60-kg bungee jumper stands at the top of a 50-m tall bridge. The jumper has a bungee secured to his ankles. The original length of the bungee is 25 meters. After falling 25 meters, the jumper reaches a maximum speed of 22m/s. He continues to fall until he comes to rest instantaneously and then is pulled back up by the bungee.** **1. What are the key parts of how the jumper, bungee cord, and bridge work together?** **2. Describe the energy transformations during the fall and return trip upward.** **3. What do you expect to happen if the mass of the jumper would increase? Explain.** **According to the law of conservation of energy, energy cannot be created or destroyed, it can only change forms. If we neglect air resistance, as a ball is dropped from a height, the gravitational potential energy lost is transformed into kinetic energy. Assume no air resistance and that g=9.8 m/s2.** **A 2-kg ball is dropped from a 40m tall bridge. How much kinetic energy does the ball lose as it falls?** **1. How much kinetic energy does the ball gain? Compute and provide a 2-3 sentence explanation.** **2. What are the consequences of drawing a boundary around the system excluding air resistance as opposed to including it?** 9-12.PS3.A3 **Sample Stems** **A student has a small cart made of a block of wood, two dowels as axles, and four compact discs for wheels. On top, the student fixes an electric motor with a propeller powered by two AA batteries. When turned on and placed on the table, the cart accelerates.**		



The following data is collected:

Description (symbol)	Value
motor potential difference (V)	3.0 V
cart mass (m)	0.40 kg
initial cart velocity (v_i)	0
distance the cart travels (Δx)	0.50 m
motor current (I)	0.25 A
compact disc radius (r)	0.06 m
final cart velocity (v_f)	0.80 m/s
time cart travels (Δt)	1.3 s

1. Identify and describe the objects in the system.
2. Explain one way to modify the cart to improve its efficiency. Use evidence and reasoning to support your claim.

9-12.PS3.B1

Sample Stems

Sunlight illuminates a piece of metal on a sidewalk.

1. Given a 50 gram mass (m), a specific heat capacity of 0.126 J/g°C (c), and a change in temperature of 16°C (Δ T), how much energy transfers to the metal?

A search for thermal cups produces several purchase options leaving the consumer to question which is the best option. Each cup creator makes claims for keeping hot drinks hot or cold drinks cold for extended periods of time. Applying science to the situation means the need for a fair test. An assortment of cups and mugs were purchased.

Table 1. Different Brands of Mugs

Brand	Size (oz)	Material	Lid	Cost
M	20	stainless steel double wall vacuum	plastic with opening	$23.00
N	14 (mug shaped)	stainless steel double wall vacuum	plastic with sliding lid	$14.00
O	20 (skinny and taller)	stainless steel double wall vacuum	plastic with opening and straw opening	$16.00
P	12 (mug shaped)	stainless steel double wall vacuum	plastic with opening	$8.00
Q	14 (cup)	disposable (paper)	thin plastic with opening	$0.32

1. Using the information provided in Table 1, design a fair test to determine which cup is the smartest purchase. Keep in mind, you are interested in a cup to keep hot drinks warm most of the day (4 to 5 hours) and cold drinks cold for longer periods of time (6 to 8 hours). Your investigation design should include a hypothesis, variables (Independent, Dependent, and Constants), control, procedure, and a blank data table (to be filled in with data).

“Unwrapped” Content (nouns) (students need to know)	“Unwrapped” Skills (VERBS) (students need to be able to do & DOK)	“Unwrapped” Understanding (students need to understand)
9-12.PS3.A2 models energy macroscopic scale combination motions particles (objects) energy	Develop Use	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).
9-12.PS3.A3 device constraints energy	Design Build Refine Convert	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
9-12.PS3.B1 investigation evidence transfer thermal energy components temperatures closed system energy distribution system (2nd of thermodynamics)	Plan Conduct	Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy distribution among the components in the system(second law of thermodynamics).

New Academic Vocabulary	Scaffolded (Review) Academic Vocabulary
macroscopic scale combination of energy constraints thermal energy components closed system uniform energy distribution	models particles energy investigation evidence system temperatures

Assessment

Common Summative Assessment/Demonstration of Understanding

- **Common Unit Assessment to be completed in the 2024-2025 School Year.**

Links to student example of summative assessments/demonstration of understanding

Score 4	Score 3	Score 2	Score 1

Example	Example	Example	Example

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	• Phenomena.app (short apps and physical processes to show students)
	Other Resources:

Curriculum Designer Notes:	○ 9-12.PS3.A2 ○ Tasks should provide students with all needed background information. Students are not required to generate their own phenomena. ○ Tasks should focus on how energy at the microscopic level is related to the macroscopic level. ○ 9-12.PS3.A3: ○ Tasks should limit quantitative evaluations to total output for a given input. ○ Tasks should provide students with all needed materials. Students are not required to generate their own materials or tools. ○ 9-12.PS3.B1: ○ Tasks should provide students with needed materials and tools. Students are not required to generate their own materials or tools. ○ Tasks may require students to calculate energy gained or lost, final or initial temperature conditions, mass, or specific heat of material using $q=mc\Delta T$, given that other variable values are known or provided.

Physical Science: Unit 6 Waves

Overview

Quarter(s): 4th

Pacing: 4 - 5 Weeks

Unit Power Standard(s) Code	Unit Power Standard(s) Description
9-12.PS4.A1	USE mathematical representations to SUPPORT a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
9-12.PS4.A2	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.
9-12.PS4.B1	COMMUNICATE technical information about how electromagnetic radiation interacts with matter.

Below Grade/Course Connected Standard(s)	Above Grade/Course Connected Standard(s)
7th grade 6-8.PS4.A.2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	N/A

Unit Supporting Standards Code	Unit Supporting Standards Description
9-12.PS4.B2	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

Unpacked Standard(s)

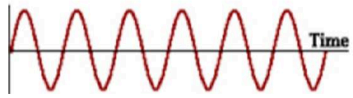
Power Standard(s) Code	Power Standard(s) Description	DOK(s)	DESE Expectation(s) Unwrapped
9-12.PS4.A1	Use mathematical representa-tions to support a claim regarding relationships among the frequency, wavelength,	3	**SCIENCE AND ENGINEERING PRACTICES** Using Mathematics and Computational Thinking • Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. DISCIPLINARY CORE IDEAS Wave Properties •

	and speed of waves traveling in various media.		The wavelength and frequency of a wave are related to one another by the speed at which the wave travels, which depends on the type of wave and the medium through which it is passing. **CROSSCUTTING CONCEPTS** Cause and Effect ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
9-12.PS4.A2	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.	3	**SCIENCE AND ENGINEERING PRACTICES** Engaging in Argument from Evidence ● Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. **DISCIPLINARY CORE IDEAS** Wave Properties ● Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. Electromagnetic Radiation ● Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. **CROSSCUTTING CONCEPTS** Systems and System Models ● Models (e.g., physical, mathematical, computer) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between systems at different scales
9-12.PS4.B1	Communicate technical information about how electromagnetic radiation	3	**SCIENCE AND ENGINEERING PRACTICES** Obtaining, Evaluating, and Communicating Information ● Communicate technical information or ideas (e.g., about phenomena and/or the process of development and the design and

	interacts with matter.		performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). **DISCIPLINARY CORE IDEAS** Energy in Chemical Processes ● Solar cells are human-made devices that capture the Sun's energy and produce electrical energy. Wave Properties ● Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. Electromagnetic Radiation ● Photoelectric materials emit electrons when they absorb light of a high-enough frequency. Information Technologies and Instrumentation ● Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. **CROSSCUTTING CONCEPTS** Cause and Effect ● Systems can be designed to cause a desired effect.
DESE Questions Examples:	9-12.PS4.A1		

Sample Stems

Imagine that the wavelength of the pictured wave is 450 nm and travels at the speed of light. Its frequency is $6.7 \times 10^{14}\ s^{-1}$.



1. What is the wavelength of another wave that travels at the same speed but has a frequency of $3.35 \times 10^{14}\ s^{-1}$?

It is well known that lightning is seen before the thunder is heard. Wavelengths of electromagnetic and sound waves can be the same.

1. Imagine that the wavelengths from the lightning and thunder are the same, what can be said about their frequencies?

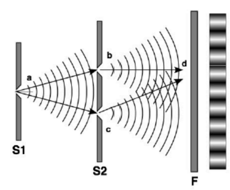
Mr. and Mrs. Smith attended a summer band concert to hear their son play his violin. When they sat down in their seats, they noticed that there were dead moments. That is, places in the music when they could not hear anything! They decided to move and sit directly in front of the band in the third row.

1. Draw a model which explains how spots where no music is heard (dead spots) were created.

9-12.PS4.A2

Sample Stems

Use the model below to explain diffraction of electromagnetic waves, specifically by addressing the following questions.



1. Describe how diffraction impacts or changes the behavior of the light waves.
2. What variables affect the behavior of light waves causing diffraction?
3. Describe an example of where you might have seen an example of light diffraction in everyday life.
4. **Part A:** How does the diffraction of mechanical waves, such as sound, compare to the diffraction of the electromagnetic waves? Same or Different (circle one)
   Part B: Explain your answer to Part A.

A. How would the model of diffraction look if we used light as a particle as the basis rather than light as a wave? Use a drawing to help explain

To help explain (last few words cutoff)

9-12.PS4.B1

Sample Stems

Both of the devices pictured below use solar energy for different outcomes.

1. Model how the sunlight heats the black pot.
2. Model how the sunlight striking the solar panel produces electricity.
3. Explain how the design of the device (system) changes the input energy (solar) to the output energy (heat or electrical).

"Unwrapped" Content (nouns) (students need to know)	"Unwrapped" Skills (VERBS) (students need to be able to do & DOK)	"Unwrapped" Understanding (students need to understand)
9-12.PS4.A1 mathematical representations claim relationships frequency wavelength speed of waves media	Use Support	The wavelength and frequency of a wave are related to one another by the speed at which the wave travels, which depends on the type of wave and the medium through which it is passing.
9-12.PS4.A2 claim evidence reasoning EM radiation wave model particle model	Evaluate	Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other.
9-12.PS4.B1 technical information EM radiation matter	Communicate	Solar cells are human-made devices that capture the Sun's energy and produce electrical energy.

New Academic Vocabulary	Scaffolded (Review) Academic Vocabulary
mathematical representations frequency wavelength speed of waves media EM radiation wave model particle model technical information	claims relationships evidence reasoning model matter waves speed matter model

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	Other Resources:

Curriculum Designer Notes:	○ 9-12.PS4.A1: ○ Tasks should be limited to qualitative descriptions of algebraic relationships. ○ Tasks should provide students with all needed formulas. ○ 9-12.PS4.A2: ○ Tasks should avoid using quantum theory. ○ Tasks should provide students with all needed background information and evidence. ○ 9-12.PS4.B1 ○ Tasks should include all needed background information. ○ Tasks are limited to qualitative information.