Dr. Frank Ranelli
Superintendent of Schools

Dr. William Baskerville
Assistant Superintendent for
Curriculum and Instruction

Content Area: Physics
Grade Span: 11-12
Revised by: Jessica Pritchard
Presented by: Jessica Pritchard
Approval date: August 2022

Piscataway Township Schools
1515 Stelton Road
Piscataway, NJ 08854-1332
732 572-2289, ext. 2561
Fax 732 572-1540
www.piscatawayschools.org

COURSE OVERVIEW

Description

This physics course gives students an understanding of the physical laws governing force and motion, conserved quantities, waves, and electricity and magnetism. This course consists of coursework that will lead to greater understanding of how mathematical models are used to describe the physical universe. Students are motivated to learn science in the context of highly engaging and authentic “real-world” projects that guide instruction and serve to organize their learning. Research shows that the project-based approach promotes excitement and meaningful learning for all students.

Goals

To provide students with learning opportunities that are designed to build scientific literacy, critical thinking, problem solving and analytical skills through the process of inquiry in physics. Students develop important 21st century skills as they work collaboratively in groups and engage in science discourse. This physics course embraces the three-dimensional learning of the Next Generation Science Standards (NGSS) and seamlessly integrates science and engineering practices, crosscutting concepts, and core ideas throughout the curriculum.

Scope and Sequence

Unit	Topic	Length
Unit 1	Kinematics (Driving the Roads)	15-18 days
Unit 2	Dynamics (Physics in Action)	15-18 days
Unit 3	Momentum (Safety)	15-18 days
Unit 4	Energy (Thrills and Chills)	15-18 days
Unit 5	Waves (Let Us Entertain You)	15-18 days

UNIT 1: KINEMATICS (Driving the Roads)

Summary and Rationale

In this unit of study, students are expected to plan and conduct investigations, analyze data and use math to support claims, and apply scientific ideas to solve and design problems. Through a series of activities, students learn about average and instantaneous speed and then connect information about reaction time, speed, and velocity to tailgating. They explore acceleration, positive and negative, in the context of the time required to bring a vehicle to a stop and decision-making at a yellow light. They also learn about centripetal force and acceleration and relate it to driving on curves. Students will also be able to apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

Recommended Pacing

15-18 days

State Standards

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Instructional Focus

Unit Enduring Understandings (Cross Cutting Concepts)

Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multi-faceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
Scale, proportion, and quantity In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
Systems and system models Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
Stability and change For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Unit Essential Questions

- Why is there a need to express some physical quantities as vectors?
- What underlying forces explain the variety of interactions observed?
- How can one predict an object's continued motion, changes in motion, or stability?

Objectives

Students will know (DCIs):
ETS1.A: Defining and Delimiting Engineering Problems 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. (HS-ETS1-1) Humanity faces major global challenges

today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)

ETS1.B: Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)

Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)

ETS1.C: Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)

Students will be able to (SEPs):

- Asking Questions
- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking
- Constructing Explanations
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

UNIT 2: DYNAMICS (Physics in Action)

Summary and Rationale

In this unit of study, students are expected to demonstrate proficiency in planning and conducting investigations and applying scientific ideas to demonstrate an understanding of core ideas. Students measure motion and learn about speed and acceleration. Through explorations, they learn about force and "discover" Newton's three laws of motion and how they relate to sports. They also investigate acceleration due to gravity as well as physical and mathematical models of projectile motion. They explore friction, calculate the coefficient of friction, and consider the effect of friction in sports. Then they learn about gravitational potential energy, kinetic energy, spring potential energy, the law of conservation of energy, and how energy and work are related.

Recommended Pacing

15-18 days

State Standards

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.	
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 falling object, an object sliding down a ramp, or a moving object being pulled by a constant force.
Assessment Boundary	Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.
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.	
Clarification Statement	Emphasis is on explaining the meaning of mathematical expressions used in the model.
Assessment Boundary	Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.
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).	
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.
HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	

Instructional Focus

Unit Enduring Understandings (Cross Cutting Concepts)

Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multi-faceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
Scale, proportion, and quantity In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Systems and system models Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
Structure and function The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
Stability and change For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Unit Essential Questions

- What underlying forces explain the variety of interactions observed?

Objectives

Students will know (DCIs):
PS2.A: Forces and Motion Newton's second law accurately predicts changes in the motion of macroscopic objects.
PS3.A: 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 a system's total energy is conserved, even as, within the system, energy 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.
PS3.B: Conservation of Energy and Energy Transfer Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. The availability of energy limits what can occur in any system.

Students will be able to (SEPs):

- Asking Questions
- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking
- Constructing Explanations
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

UNIT 3: MOMENTUM (Safety)

Summary and Rationale
Students use Newton's first law to describe what happens during a collision and apply the concept of pressure to the design of a seatbelt. They observe the effect of spreading a force over a greater distance and explain their observations using the work-energy theorem. After exploring the effects of a rear-end collision, they use Newton's laws to describe how whiplash occurs. Students investigate the law of conservation of momentum by analyzing collisions. They measure velocity and force on a vehicle during impact and describe the relationship between impulse and momentum. Students are expected to demonstrate proficiency in using mathematical and computational thinking and to use this practice to demonstrate understanding of core ideas.

Recommended Pacing
15-18 days

State Standards	
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.	
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 falling object, an object sliding down a ramp, or a moving object being pulled by a constant force.
Assessment Boundary	Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.
HS-PS2-2. 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.	
Clarification Statement	Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.
Assessment Boundary	Assessment is limited to systems of two macroscopic bodies moving in one dimension.
HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*	
Clarification Statement	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.
Assessment Boundary	Assessment is limited to qualitative evaluations and/or algebraic manipulations.
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.	
Clarification Statement	Emphasis is on explaining the meaning of mathematical expressions used in the model.
Assessment Boundary	Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.
HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	
HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Instructional Focus

Unit Enduring Understandings (Cross Cutting Concepts)

Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multi-faceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
Scale, proportion, and quantity In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
Systems and system models Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
Structure and function The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
Stability and change For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Unit Essential Questions

- How can you measure velocity and force?
- What is the relationship between impulse and momentum?

Objectives

Students will know (DCIs):
PS2.A: Forces and Motion Newton's second law accurately predicts changes in the motion of macroscopic objects. Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.
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.
PS3.A: 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 a system's total energy is conserved, even as, within the system, energy 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.

Students will be able to (SEPs):

- Asking Questions
- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking
- Constructing Explanations
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

UNIT 4: ENERGY (Thrills and Chills)

Summary and Rationale

In this unit of study, students develop and use models, plan and carry out investigations, use computational thinking and design solutions as they make sense of the disciplinary core idea. Students use gravitational and potential energy to explain their observations of a ball rolling down an incline and a swinging pendulum. They investigate spring potential energy and explore the law of conservation of energy. They determine the relationship between gravitational force and distance. Students learn about the difference between mass and weight, and determine Hooke's law and calculate spring potential energy. Newton's second law for net forces is used to analyze a free-body diagram for objects undergoing acceleration. Students investigate centripetal force and apply it to a roller coaster. They pull a mass up different routes to a fixed height and develop a definition of work and its relationship to power. Students develop concept maps on force and energy and explore examples of each on a roller coaster. Students are expected to demonstrate proficiency in developing and using models, planning and carry out investigations, using computational thinking and designing solutions, and they are expected to use these practices to demonstrate understanding of core ideas.

Recommended Pacing

15-18 days

State Standards

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.	
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 falling object, an object sliding down a ramp, or a moving object being pulled by a constant force.
Assessment Boundary	Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.
HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.	
Clarification Statement	Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.
Assessment Boundary	Assessment is limited to systems with two objects.
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.	
Clarification Statement	Emphasis is on explaining the meaning of mathematical expressions used in the model.
Assessment Boundary	Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.
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.*	
Clarification Statement	Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.
Assessment Boundary	Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.
HS-PS3-5. 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.	

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.
Assessment Boundary	Assessment is limited to investigations based on materials and tools provided to students.

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Instructional Focus

Unit Enduring Understandings (Cross Cutting Concepts)

Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multi-faceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
Scale, proportion, and quantity In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
Systems and system models Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
Structure and function The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
Stability and change For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Unit Essential Questions

- How is energy transferred and conserved?
- How do you identify a system and external objects interacting with the system?

Objectives

Students will know (DCIs):
PS2.A: Forces and Motion Newton's second law accurately predicts changes in the motion of macroscopic objects. Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.

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.

PS2.B: Types of Interactions Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.

Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.

PS3.D: 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.

ETS1.A: 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. (secondary)

PS3.B: 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).
PS3.D: 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.

Students will be able to (SEPs):

- Asking Questions
- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking
- Constructing Explanations
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

UNIT 5: WAVES (Let Us Entertain You)

Summary and Rationale

Students connect vibrations and waves to sound. They observe transverse and longitudinal waves and investigate the relationship between speed and amplitude, medium on wave speed, the principle of superposition, and the relationship between speed and frequency, in order to construct instruments for their sound show. To design their light show, students explore reflected light, plane and curved mirrors, refraction of light, the effect of lenses, and color. In this unit of study, students apply their understanding of how wave properties can be used to transfer information across long distances, store information, and investigate nature on many scales. The crosscutting concept of cause and effect is highlighted as an organizing concept for these disciplinary core ideas. Students are expected to demonstrate proficiency in using mathematical thinking, and to use this practice to demonstrate understanding of the core idea. Students will explore sound in more depth than waves in other media.

Recommended Pacing

15-18 days

State Standards

HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

Clarification Statement	Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.
Assessment Boundary	Assessment is limited to algebraic relationships and describing those relationships qualitatively.

HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information.

Clarification Statement	Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. NG

Instructional Focus

Unit Enduring Understandings (Cross Cutting Concepts)

Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multi-faceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
Scale, proportion, and quantity In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
Systems and system models Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
Structure and function The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
Stability and change For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Unit Essential Questions
● How can we identify that something is a wave? ● How are waves used to transfer energy, and send and store information?
Objectives
Students will know (DCIs): **PS4.A: Wave Properties** The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. 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. **Students will be able to (SEPs):** ● Asking Questions ● Developing and Using Models ● Planning and Carrying Out Investigations ● Analyzing and Interpreting Data ● Using Mathematics and Computational Thinking ● Constructing Explanations ● Engaging in Argument from Evidence ● Obtaining, Evaluating, and Communicating Information