CORE IDEAS	Established Goals	Understanding of Concepts	Essential Questions	Student Outcomes
GRADE SIX				
Core Idea: **Wave Properties** **PS4.A, PS3.A** **Topic: Building Wave Background Knowledge** **Title: *Good Vibrations: Using Sound Waves to Communicate* – Lessons 1 and 2**	• A simple wave has a repeating pattern with a specific wavelength, frequency and amplitude. • A sound wave needs a medium through which it is transmitted. Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet. • Energy can be moved from place to place…through sound…	• A simple wave has a repeating pattern of motion. • A simple wave has a specific crest, trough, wavelength, frequency and amplitude. • Waves share common characteristics of wavelength, frequency and amplitude. • These characteristics can be measured. • Propagation of a wave is how it travels. • Waves get weaker as they travel outward from the source. • The source creates the wave.	• How do waves behave? • How do we measure wave properties?	• Identify the common characteristics of waves (wavelength, crests, troughs) and their behavior (frequency and amplitude). • Identify the source of a wave and describe propagation as the way waves move.
Core Idea: Wave Properties **PS4.A, PS3.A** **Topic: Mechanical Waves** **Title: *Slinky Compression Waves*- Lesson 3**	• A simple wave has a repeating pattern of specific wavelength, frequency and amplitude. • A sound wave needs a medium through which it is transmitted. • Energy can be moved from place to place through sound.	• Sound waves and rope waves are mechanical waves. • Rope waves move up and down (transverse to the direction of travel of the wave). • Sound waves are compression waves, not transverse waves. • There are two different types of waves: transverse and compression.	• How do sound waves compare to water waves and rope waves? • How can a slinky or spring be used to demonstrate both transverse and compression waves? • What are transverse and compression waves? How do they compare?	• Identify rope waves as transverse waves. • Identify slinky waves as compression waves. • Identify sound waves as compression waves. • Identify compressions and rarefactions in slinky waves.

Core Idea: Information Technologies & Instrumentation **PS4.A, PS3.A, ETS1** **Topic: String Telephone** **Title: *Can You Hear Me Now? Can vs Cup* - Lesson 4**	• A simple wave has a repeating pattern of specific wavelength, frequency and amplitude. • A sound wave needs a medium through which it is transmitted. • Energy can be moved from place-to-place through sound. • The steps in the engineering process include: defining and delimiting an engineering problem; developing possible solutions; and optimizing the design solution.	• Sound waves are mechanical waves. • The simplest way to get a message to another person is person-to-person communication. • When the distance increases to the degree that person communication is not possible, a device is used to assist in the delivery of the message.	• How are rope and water waves like sound waves? • How are they different? • What is the easiest way for you to get a message to someone else? • What are some mediums through which mechanical waves travel? • What do you do when people are far away and you need to get a private message to them?	• Identify sound as a mechanical wave, similar to a rope or water wave. • Recognize that the easiest way to get a message to another person is through direct person-to-person communication. • Identify air particles as the medium through which sound can travel. • Construct a working can/cup and string. • Evaluate the performance of various can/cup and string telephones.
Core Idea: Information Technologies & Instrumentation **PS4.A, PS3.A, ETS1** **Topic: String Telephone** **Title: *Can You Hear Me Now? String, Twine, Thread, Wire* - Lesson 5**	• A simple wave has a repeating pattern of specific wavelength, frequency and amplitude. • A sound wave needs a medium through which it is transmitted. • Energy can be moved from place-to-place through sound. • The steps in the engineering process include: defining and delimiting an engineering problem; developing possible solutions; and optimizing the design solution.	• Sound waves are mechanical waves. • The simplest way to get a message to another person is person-to-person communication. • When the distance increases to the degree that person-to-person communication is not possible, a device is used to assist in the delivery of the message.	• What is the medium through which sound waves travel? • What do you do when people are far away and you need to get a private message to them? • How can we improve the string telephone. • What is the best medium for a string telephone? • Why do you think this is so?	• Identify sound as a mechanical wave, just like a rope or water wave? • Recognize that the easiest way to get a message to another person is through direct person-to-person communication. • Identify air particles and different types of string/twine/thread as mediums through which mechanical waves can travel. • Construct a working can/cup and string telephone. • Evaluate the performance of various string materials.

Core Idea: Information Technologies & Instrumentation **PS4.A, PS3.A, ETS1** **Topic: String Telephone** **Title:** ***Can You Hear Me Now? Distance*** **Lesson 6**	• A simple wave has a repeating pattern of specific wavelength, frequency and amplitude. • A sound wave needs a medium through which it is transmitted. • Energy can be moved from place-to-place through sound. • The steps in the engineering process include: defining and delimiting an engineering problem; developing possible solutions; and optimizing the design solution.	• Sound waves are mechanical waves. • The simplest way to get a message to another person is person-to-person communication. • When the distance increases to the degree that person-to-person communication is not possible, a device is used to assist in the delivery of the message. • A string and can/cup telephone is such a device.	• What are the limitations of the string telephone? • Why do you think this is so? • How does string length affect sound waves in a string and can/cup telephone?	• Identify sound as a mechanical wave, just like a rope or water wave. • Recognize that the easiest way to get a message to another person is through direct person-to-person communication. • Identify air particles and different types of string/twine/thread as mediums through which mechanical waves can travel. • Construct a working can/cup and string telephone. • Evaluate the performance of various string lengths.
Core Idea: Information Technologies & Instrumentation **PS4.A, PS3.A** **Topic: Using Sound Waves for Communication** **Title:** ***Exploring Sound Wave Travel in a Balloon and Vacuum-*** **Lesson 7**	• A simple wave has a repeating pattern with a specific wavelength, frequency and amplitude. • A sound wave needs a medium through which it is transmitted. Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet. • Energy can be moved from place to place…through sound…	• Sound waves are mechanical waves. • A wave is a distortion or disturbance that carries energy in a material or medium. • Sound waves need a medium through which to travel.	• How does sound travel in outer space? • Would a string telephone be a device or technology that could be used to communicate in outer space?	• Recognize that sound waves can be felt. • Identify the string telephone as an ineffective way to communicate in outer space as sound waves are unable to travel in a vacuum or in the absence of a medium.

Core Idea: Information Technologies & Instrumentation **PS3.B, PS3.C, ETS1** **Topic: Electromagnets** **Title: *Properties of Electromagnets & Using Electromagnets to Solve Problems* – Lesson 8**	• Energy can be transferred from place-to-place by electric currents, which can then be used locally to produce motion, sound, heat or light. • Magnets can exert forces on other magnets or magnetizable materials. • The steps in the Engineering Design Process include: defining and delimiting an engineering problem: developing possible solutions; and optimizing the design solution.	• Electricity can make magnetism and magnetism can make electricity. • Electromagnets can be used to produce electricity, movement and sound. • Magnetism affects a compass.	• What is the largest magnet in the world? • How does electromagnetism work? • How can electromagnet devices be used to solve problems?	• Recognize planet Earth as the largest magnet in the world. • Construct a generator or electromagnet project that solves a problem. • Evaluate the performance of the project and make improvements as needed. • Apply the steps of the engineering design process.
Core Idea: Information Technologies and Instrumentation **PS3.B, PS4.C** **Topic: Morse Code** **Title: *Morse Code Communication* – Lesson 9**	• Energy can be transferred from place-to-place by electric currents, which can then be used locally to produce motion, sound, heat or light. • Appropriately designed technologies make it possible to detect and interpret many types of signals that cannot be sensed directly. • When in digitized form, information can be recorded, stored for future recovery, and transmitted over long distances without significant degredation.	• When the distance increases to the degree that person-to-person communication is not possible, a device is used to assist in the delivery of the message. • A Morse Code system is such a device. • Sound waves need a medium through which to travel.	• How did people improve person-to-person communication beyond the string can telephone, but before the invention of the telephone? • How did Samuel Morse use electricity and the electromagnet to improve person-to-person communication? • What is the medium through which Morse code travels?	• Use MC (Morse Code) sounder boards to create a telegraph system across the classroom and send a message to a student hidden on the other side of the room.

Core Idea: Information Technologies & Instrumentation **PS3.B, PS4.A, PS4.C** **Topic: Audio Speakers** **Title: *Build a Speaker* – Lesson 10**	• Energy can be transferred from place-to-place by electric currents, which can then be used locally to produce motion, sound, heat or light. • Waves, which transfer energy and any encoded information without the bulk motion of matter, can travel unchanged over long distances and be detected and decoded far from where they were produced. • Appropriately designed technologies make it possible to detect and interpret many types of signals that cannot be sensed directly.	• A speaker is a device that converts an electrical current into sound waves. • The speaker then uses an electromagnet placed in the field of a permanent magnet to vibrate the cone of the speaker to produce sound waves. • A plastic cup can be used as a speaker cone which will function when properly assembled with a boom box body, a coil of wire, and a powerful magnet.	• What are the essential components of a speaker? • How does a speaker work? • How does a speaker make sound?	• Recognize an electromagnet and a permanent magnet as the key components in making the cone of a speaker move (plastic cup). • Recognize that the plastic cup speaker moves because an electromagnet inside of it is either attracted or repelled by a permanent magnet. This attraction and repulsion causes the cone of the speaker move. • Recognize that the movement of the cone of the speaker (plastic cup) creates compression waves that travel to our ears and we interpret as sound.

Core Idea: Information Technologies & Instrumentation **PS3.B, PS4.A, PS4.C** **Topic: PA Systems** **Lesson 11: *PA System Communication* – Lesson 11**	• Energy can be transferred from place-to-place by electric currents, which can then be used locally to produce motion, sound, heat or light. • Waves, which transfer energy and any encoded information without the bulk motion of matter, can travel unchanged over long distances and be detected and decoded far from where they were produced. • Appropriately designed technologies make it possible to detect and interpret many types of signals that cannot be sensed directly.	• When the distance and size of a crowd increases to the degree that person-to-person communication is not an effective means of communication, a device is used to assist in the delivery of the message. • A PA (public address) system is a communication system that is intended for one person to deliver a message to a larger group.	• How do you get a message out to a crowd of people? • How can one person communicate with thousands at one time? • What technologies need to be utilized for this to happen?	• Recognize the PA (public address) system as a means for person to group communications. • Recognize electricity, the microphone, and the speaker (which uses an electromagnet) as key components of the PA system in that they are devices necessary for the encoding and decoding of the sound wave.

Core Idea: Information Technologies & Instrumentation **PS3.B, PS4.A, PS4.C** **Topic: Telephone Communications** **Title: *Phone-to-Phone/Party Line Communication* – Lesson 12**	• Energy can be transferred from place-to-place by electric currents, which can then be used locally to produce motion, sound, heat or light. • Waves, which transfer energy and any encoded information without the bulk motion of matter, can travel unchanged over long distances and be detected and decoded far from where they were produced. • Appropriately designed technologies make it possible to detect and interpret many types of signals that cannot be sensed directly.	• Alexander Graham Bell was able to improve the available technology of the telegraph by inventing the first telephone. • A telephone handset has a microphone and a speaker. • Creating a telephone network allows subscribers to call many different people in different locations.	• How does a wired telephone system work? • What technologies need to be utilized for this to happen?	• Connect two telephones to a central office and talk to each other. • Connect more than two telephones to the central office to create a "party line." • Utilize this communication system to make group plans.

Core Idea: Engineering Design **PS4.C, ETS1** **Topic: Telephones – Past and Present** **Title:** ***History of Telephone Communication and Beyond*** **Lesson 13**	• Appropriately designed technologies make it possible to detect and interpret many types of signals that cannot be sensed directly. • The creative process of developing a new design to solve a problem is a central element of engineering. • A solution needs to be tested and then modified on the basis of the test results in order to improve it. • Multiple solutions to an engineering design problem are always possible. • The steps in the Engineering Design Process include: defining and delimiting an engineering problem: developing possible solutions; and optimizing the design solution.	• Wired telephone devices evolved and were improved over time. • The work of past engineers and scientists prepare for future inventions and innovations in communication. • Wired telephones use speakers and microphones to transmit and receive sound waves. • Wireless telephones use radio waves, not mechanical waves.	• How did the telegraph evolve into our person-to-person telephones and cell phones of today? • How did telephones move from wired to wireless? What were the technologies, and how did they evolve? • How is this evolution reflective of the engineering design process?	• Recognize a variety of historic devices as telephones (such as the wall phone and candlestick phone). • Compare and contrast a variety of telephone devices. • Recognize innovations that would impact communication devices such as microchips, memory cards, and plastic.