Pennsylvania Science Grade 8 Performance Level Descriptors		
Basic	**Proficient**	**Advanced**
A student performing at the **Basic Level** demonstrates partial command of the knowledge, skills, and practices defined in the Pennsylvania Academic Standards for the tested grade(s). This level of performance is considered marginal, indicating that the student is approaching but not yet meeting expectations and may require targeted academic support, either occasional or ongoing, for the student to participate in and keep up with grade level instruction in the next school year.	A student performing at the **Proficient Level** demonstrates adequate command of the knowledge, skills, and practices defined in the Pennsylvania Academic Standards for the tested grade(s) and meets expectations. This level of performance is considered satisfactory, indicating that the student is academically prepared to participate in and keep up with grade level instruction in the next school year when provided with Tier 1 instruction.	A student performing at the **Advanced Level** demonstrates thorough command of the knowledge, skills, and practices defined in the Pennsylvania Academic Standards for the tested grade(s) and exceeds expectations. This level of performance is considered superior, indicating that the student is academically prepared for grade level instruction in the next school year, including challenging content.
A student at this level is able to do the following:	**A student at this level is able to do the following:**	**A student at this level is able to do the following:**
• make observations from an investigation and infer that living things are made of cells.	• conduct an investigation using technology to make observations that can support the idea that living things are composed of one cell or multiple cells.	• design and conduct an investigation to generate evidence that living things are composed of one cell or multiple cells and different types of cells.
• use a model of a simple cell to describe the function of a cell part.	• develop or use a model of cell types (e.g., nerve, skin) to explain how a specific cell part (e.g., cell membrane) is related to the cell's function.	• develop and use a model of cell types to explain how specific cell parts (e.g., cell membrane, mitochondria) work together to make the whole cell function.
• recognize evidence that an organism's body is a system of interacting subsystems.	• use an argument, supported by one source of evidence, to infer that an organism's body is a system of interacting subsystems (e.g., circulatory and respiratory systems).	• construct an argument supported by one source of evidence to infer that that an organism's body is a system of interacting subsystems composed of groups of cells.
• recognize examples of sensory receptors responding to stimuli.	• gather and compare information to use as evidence that sensory receptors send messages to the brain when responding to a stimulus.	• synthesize information to use as evidence that when responding to a stimulus, sensory receptors send messages to the brain for immediate response and/or as memory storage.
• use observations as evidence to explain how some plants use colorful flowers to attract pollinators and reproduce.	• make direct observations from an investigation to use as evidence to support the idea that flower color in some plants can result in successful reproduction.	• construct an argument based on evidence and scientific reasoning to support the idea that flower color in some plants can result in successful reproduction.
• use evidence to explain how an environmental or genetic factor can influence the growth of organisms.	• use evidence to explain how environmental and genetic factors can influence the growth of organisms.	• construct a scientific argument from evidence to explain how environmental and genetic factors can influence the growth of organisms.
• use a model to recognize that structural changes in genes may affect proteins.	• use or complete a model to describe that changes in genes may affect proteins.	• develop and use a model to explain that changes in genes may have variable effects on structures and their functions within an organism.
• use a model to recognize examples of sexual or asexual reproduction.	• use or refine a model to describe different possible genetic outcomes of sexual or asexual reproduction.	• construct a model to compare or predict possible genetic outcomes of sexual and asexual reproduction.

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Pennsylvania Science Grade 8 Performance Level Descriptors		
Basic	**Proficient**	**Advanced**
• recognize examples that humans have influenced the inheritance of other organisms (e.g., selective breeding).	• gather and compare information to explain how genetic engineering can influence the inheritance of desirable traits in organisms.	• synthesize information from more than one source to evaluate how genetic engineering can influence the inheritance of desirable traits in organisms.
• use scientific information as evidence to explain a function of photosynthesis within an ecosystem.	• construct a scientific explanation based on evidence to describe a function of photosynthesis in the cycling of matter or flow of energy within an ecosystem.	• refine a scientific explanation based on evidence to explain how changes in photosynthesis could affect the cycling of matter and flow of energy within an ecosystem.
• use a model to understand that molecules are changed and new ones are made through chemical reactions as matter moves through an organism.	• develop a model to describe how molecules are broken down and new ones are made through chemical reactions that can support growth and/or release energy as matter (food) moves through an organism.	• enhance a model to demonstrate how molecules are broken down and new ones are made through chemical reactions that can support growth and/or release energy as matter moves through an organism.
• use data as evidence of a change that affects an organism based on resource availability.	• analyze data to provide evidence of a change that affects an organism or a population of organisms based on resource availability.	• analyze and interpret data to provide evidence of interacting changes that affect an organism or a population of organisms based on resource availability.
• use a model to demonstrate how matter cycles or energy flows within an ecosystem.	• construct a model to describe how matter cycles and energy flows within an ecosystem.	• refine a model to explain how matter cycles and energy flows within an ecosystem.
• use observations as evidence to recognize that physical or biological changes to an ecosystem can affect a population.	• make direct observations from an investigation to use as evidence to support that physical or biological changes to an ecosystem can affect populations.	• construct an argument based on evidence to infer a pattern on how changes to physical or biological components of an ecosystem affect interacting populations.
• use evidence to describe interactions among organisms in an ecosystem.	• construct an explanation that uses a pattern to predict interactions among organisms within an ecosystem.	• construct an explanation that uses patterns to predict interactions among organisms between two ecosystems.
• recognize a design solution that helps to maintain the balance of biodiversity in an ecosystem.	• evaluate two competing design solutions to determine how best to maintain the balance of biodiversity in an ecosystem (e.g., scientific, economic, and/or social solutions).	• evaluate more than two competing design solutions to justify how best to improve the balance of biodiversity in an ecosystem.
• use scientific data to recognize observable patterns in the fossil record.	• analyze scientific data and make conclusions based on the observable patterns in the fossil record.	• evaluate and interpret scientific data in the fossil record to explain past extinction events and current biodiversity.
• use scientific thinking to recognize similarities and differences among modern organisms.	• construct a scientific explanation based on observable physical characteristics, which are similar or different among modern organisms and infer any relatedness.	• construct a scientific explanation using similarities and differences between prehistoric and modern organisms and infer any relatedness.
• use pictures of multiple types of organisms at different stages of development to identify similarities.	• analyze pictures of multiple types of organisms at different stages of development to compare patterns of similarities.	• analyze pictures of multiple types of organisms at different stages of development to evaluate patterns of similarities and make conclusions.

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Pennsylvania Science Grade 8 Performance Level Descriptors		
Basic	**Proficient**	**Advanced**
• use evidence to identify genetic variation of traits in a population.	• construct an explanation using one source of evidence to describe how genetic variations in a population of organisms (e.g., white-tailed deer) affect their ability to survive and reproduce in a specific environment.	• refine an explanation using multiple sources of evidence to evaluate how genetic variations in a population of organisms affect their ability to survive and reproduce in a specific environment.
• use mathematical representations to show how natural selection may cause changes in the frequency of specific traits in a population over time.	• use mathematical representations to support explanations of how natural selection may cause changes in the frequency of specific traits in a population over time.	• use mathematical representations to predict how natural selection may cause changes in the frequency of specific traits in a population over time.
• use or complete a simple model to show how parts of agricultural and food systems function.	• develop a model (e.g., inputs/outputs, people, resources/logistics such as transportation, funding) to describe how a commodity (i.e., food, fiber, energy) goes from a natural resource to production to the consumer (e.g., mining, power, forest and agricultural products).	• develop and use a complex model to predict how changes (e.g., human activities, global events, sustainable vs. unsustainable practices) can affect a food, fiber or energy system.
• use data associated with natural resources to describe differences in daily water use across different states, countries, or cultures.	• analyze data associated with natural resources (e.g., water, agriculture, recycling and waste management, fossil fuels, land) to make conclusions about how different societies manage resources.	• analyze and interpret data associated with natural resources to make predictions and assess the sustainability of societal systems (i.e., economic, social).
• use or complete a simple watershed or wetland system model and make conclusions based on evidence.	• develop a model to describe how a watershed or a wetland functions as a natural system, including roles and functions it serves (e.g., water quality, wildlife habitat, filtration, flood mitigation).	• refine and use a model of a natural Pennsylvania watershed system with multiple wetlands to explain beneficial roles and functions of the watershed.
• process information from multiple sources about a simple environmental issue in Pennsylvania to make general conclusions about the impact that issue has on humans in Pennsylvania.	• analyze information from multiple sources about an environmental issue (e.g., pollution, urbanization, emerging contaminants) in Pennsylvania and use as evidence to describe an impact that issue has on humans in Pennsylvania.	• synthesize information from multiple sources about an environmental issue in Pennsylvania and use scientific reasoning to evaluate multiple impacts that issue has on natural systems in Pennsylvania (e.g., sedimentation, nutrient loading, indoor or outdoor air quality, urban heat islands).
• organize or process environmental data related to an environment in Pennsylvania.	• analyze environmental data (e.g., weather, water resource, biodiversity, air quality) to describe an environment in Pennsylvania.	• analyze and interpret environmental data for an environment in Pennsylvania to make an inference about the stability of the environment.
• use information to determine possible benefits of a pest management solution.	• analyze information about an integrated pest management solution to describe the benefits of the solution.	• synthesize and evaluate information about multiple integrated pest management solutions to determine the best solution given the situation.
• process information about a resource management practice to validate it can support environmental sustainability.		

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Pennsylvania Science Grade 8 Performance Level Descriptors

Basic	Proficient	Advanced
	• analyze a resource management practice or environmental law to describe how it is designed to achieve environmental sustainability.	• synthesize and evaluate multiple resource management practices and environmental laws to explain how they can work together and achieve environmental sustainability.
• compare two possible solutions to an environmental issue that includes individuals or societal engagement as stewards of the environment.	• design a solution to an environmental issue that includes individuals or societal engagement as stewards of the environment (e.g., nitrogen runoff from a large dairy farm into a nearby waterway that flows into the Susquehanna River, which then affects aquatic organisms).	• evaluate and refine a solution to a complex environmental issue that involves both individuals and societal engagement as stewards of the environment.
• use an explanation as evidence to describe a regional environmental condition and its implication on the environment or society.	• construct an explanation to describe a regional environmental condition and its implication on the environment and society.	• evaluate and refine an explanation to describe regional environmental conditions and their implications on the environment and society.
• complete a model of a simple molecule by choosing from atoms and building a structure.	• develop a model to describe the atomic composition of a simple molecule (e.g., water, carbon dioxide) or an extended molecule (e.g., sodium chloride, diamond).	• develop two models to compare the atomic composition of a simple molecule and the atomic composition of an extended molecule.
• complete a model to show the energy flow entering or exiting a system and a change of state (e.g., freezing, melting).	• develop a model to describe changes in particle motion when thermal energy is added or removed.	• refine a model to predict what occurs when thermal energy is added or removed from a pure substance to determine changes in particle motion, temperature and state of the pure substance.
• summarize simple information to describe how a natural resource is used to produce a synthetic material.	• process and analyze information from one source to describe how a natural resource is used to produce a synthetic material that impacts society.	• evaluate and synthesize complex information from multiple sources to describe how natural resources are used to produce synthetic materials that impact society.
• identify the kind of change (physical or chemical) that a substance has undergone based on data that provide information about the properties before and after the change occurred.	• analyze data (e.g., melting point, density, odor) and infer that a chemical reaction has occurred based on substance properties of reactants and products (e.g., mixing zinc with hydrogen chloride).	• compare and interpret data for an interaction that results in a chemical reaction (e.g., mixing zinc with hydrogen chloride) and an interaction that does not result in a chemical reaction (e.g., dissolving salt in water) to determine where chemical reactions occurred.
• use or complete a model that shows the total number of atoms does not change in a chemical reaction, and mass is conserved.	• develop a model to describe how the total number of atoms does not change in a chemical reaction, and mass is conserved.	• develop and use a model to explain why the total number of atoms does not change in a chemical reaction, and mass is conserved.
• test two devices and compare results, as part of a design project, showing whether each device releases or absorbs thermal energy by chemical processes.	• construct and test a device, as part of a design project, that either releases or absorbs thermal energy by chemical processes.	• construct, test, and use data to refine a device, for a design project, that either releases or absorbs thermal energy by chemical processes.
• use Newton's Third Law to determine a solution for a problem involving the motion of two colliding objects.		

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Pennsylvania Science Grade 8 Performance Level Descriptors

Basic	Proficient	Advanced
• investigate that the change in an object's motion can depend on the sum of the forces on the object and/or the mass of the object.	• apply Newton's Third Law to design a solution for a problem involving the motion of two colliding objects.	• apply Newton's Third Law to refine a design solution for a problem involving the motion of two colliding objects.
	• plan an investigation to provide evidence that the change in an object's motion (e.g., hovercraft, cart on a track) depends on the sum of the forces on the object and the mass of the object.	• refine an investigation to provide more valid evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
• use data to determine if a physical property of an electromagnet (e.g., number of wires around a magnet) affects the output of the electromagnet (e.g., force of magnet).	• ask questions about data (e.g., number of wires around a magnet, size of magnets, direction of magnetic force) to determine factors that affect the strength of magnetic and electric forces (e.g., force of magnet, speed or direction of electric motor).	• evaluate data and infer how the physical properties of an electromagnet influence the output of the electromagnet.
• given data on the amount of force between two objects and their masses, construct a simple mathematical model that can be used to argue that two masses are attracted.	• construct a mathematical model (e.g., graph) that can be used to argue that two masses are attracted to each other and the greater their masses, the greater the gravitational interaction (force) between them.	• construct a mathematical model that can be used to argue that two masses are attracted to each other and explain the phenomenon in terms of the concepts involved.
• given a data set regarding an experiment that uses a variety of electrically charged items, identify the existence of fields between objects even though the objects are not in contact with each other.	• given a scenario that uses a variety of electrically charged items (e.g., sticky tape, pith balls), design an experiment changing one variable at a time (type of charge, distance between objects) that provides evidence for the existence of fields between objects even though the objects are not in contact with each other.	• given a scenario that uses a variety of electrically charged items, evaluate an experiment changing one variable at a time (type of charge, distance between objects) that provides evidence for the existence of fields between objects even though the objects are not in contact with each other.
• correctly use a graph about kinetic energy and mass (e.g., riding a bicycle, rocks rolling down a hill) to describe the relationship between the concepts.	• create a graph based on information about kinetic energy and mass as well as kinetic energy and speed for an experiment (e.g., riding a bicycle, rocks rolling down a hill) and explain what the graph reveals about the relationships (direct, indirect).	• evaluate the potential for a change in kinetic energy as the mass of objects are varied in experiments (e.g., riding a bicycle, rocks rolling down a hill) then explain the direct/indirect relationship.
• identify a model that minimizes or maximizes thermal energy transfer.	• design, construct and test thermal gain and loss from insulating an object and measuring temperature changes.	• design, construct and test thermal gain and loss from insulating an object, measuring temperature changes, and aiming to maintain a specific range of temperature.
• review experimental results to explain the relationship between energy (thermal) and one of the variables (e.g., type of matter, average kinetic energy of particles as measured by temperature, mass).	• plan an experiment to determine the relationship between energy (thermal) and one of these variables (e.g., type of matter, average kinetic energy of particles as measured by temperature, the mass).	• plan experiments to determine the relationship between energy (thermal) and multiple variables (e.g., type of matter, average kinetic energy of particles as measured by temperature, the mass).
• given data on a change in kinetic energy (e.g., car slowing down) of an object, choose an argument to support the claim that kinetic energy is transferred from the cart.		

Pennsylvania Science Grade 8 Performance Level Descriptors

Basic	Proficient	Advanced
• complete a model that explains how the quantity of potential energy between objects (roller coaster-earth, magnet-magnet, electrostatic) changes as the distance between the objects changes.	• given data on a change in kinetic energy (e.g., slowing down, hitting a ball) of an object (e.g., ball, cart), create an argument (e.g., scenario) to support the claim that kinetic energy is transferred from or to the original object.	• construct a scenario that supports the claim that kinetic energy is transferred from or to the original object using change in kinetic energy and where the energy is transferred.
• using a graph of wave type (e.g., sound, water), use the amplitude of various waves to predict the qualitative amount of energy (volume of sound wave, destructive force of a water wave).	• develop a model (e.g., diagram, picture, written explanation) that explains how the quantity of potential energy between objects (roller coaster-earth, magnet-magnet, electrostatic) changes as the distance between the objects changes.	• develop a model that predicts how the quantity of potential energy between objects (roller coaster-earth, magnet-magnet, electrostatic) changes as the distance between the objects changes.
• use a model of a wave to predict the outcome (i.e., reflected, absorbed) when the wave interacts with a different material (i.e., soft or hard material).	• using a graph of waves (e.g., sound, wave on a spring, water) with three different amplitudes, use the amplitude of various waves to predict the quantitative amount of energy (e.g., volume of sound wave, destructive force of a water wave).	• given a scenario that provides wave height data after an oceanic earthquake, describe the energy changes that occur within an increase in magnitude of the earthquake and describe the effect it will have on the resulting wave height.
• use qualitative information of analog and digital signals under a situation to support the claim that digital signals are more reliable way to encode and transmit information.	• use a model (e.g., drawing, simulation, written description) of a wave (e.g., sound, light, on a spring) to predict the outcome (e.g., transmitted, reflected, absorbed) when the wave interacts with a different material (e.g., different states of matter, amount of translucence, size of spring).	• develop a model of a wave to predict the outcome when the wave interacts with a different material.
• using a given diagram, determine which hemisphere is experiencing a particular season.	• use qualitative scientific and technical information (e.g., graphs, diagrams, written explanations) of analog and digital signals (e.g., fiber optics, radio waves, conversion of binary patterns) under various situations (e.g., interference) to support the claim that digital signals are more reliable way to encode and transmit information.	• use qualitative scientific and technical information of analog and digital signals under various situations to justify the claim that digital signals are more reliable way to encode and transmit information.
• develop a model that compares the gravitational pull between a planet and its moon(s).	• explain the reasons for lunar phases, eclipses and the seasons based on the positions of Earth, the Moon, and the Sun in a given model.	• given a particular lunar phase or solar/ lunar eclipse, create a diagram to illustrate how the positions of Earth, the Moon and the Sun cause these occurrences.
• given data about the orbital radius of the planets, justify the location of Earth from the Sun within our solar system.	• develop a model that compares the gravitational pull of a planet to one of its moons and compares it to the Sun's gravitational pull on that planet.	• use a data chart with orbital times that it takes for the Sun to orbit the Milky Way and the various planets to orbit the Sun to develop a model that shows how the gravitational pull of an object is related to its orbital times.
• given a diagram of rock strata, determine the age of a specific layer based on its position.	• given data about the orbital radius of the planets, identify the inner and outer planets within our solar system.	• using a scenario that explains how astronomers communicate with satellites that are in orbit and throughout our solar system, justify why close Earth orbiting satellites can react quicker than those that are orbiting the outer planets.

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Pennsylvania Science Grade 8 Performance Level Descriptors

Basic	Proficient	Advanced
• explain that some changes to Earth's surface are rapid (e.g., landslide) while others can take more time (erosion).	• given a diagram of rock strata (e.g., Grand Canyon), determine the relative ages of the layers.	• using a data set that shows the type and frequency of trilobite fossils found in Pennsylvania over time, infer their evolutionary path and justify that they are extinct.
• given a current global map of the major continents, infer how the shape of some coastlines once fit together.	• use diagrams to describe characteristics (e.g., causes, time and spatial scale) of processes that change Earth's surface (e.g., weathering, erosion, meteor impacts).	• compare two difference processes that change Earth's surface in variable time and spaces.
• given an incomplete diagram of the rock cycle, complete the missing part of the diagram.	• given data about similarities in rock layers found in different continents along the Atlantic ocean, infer the plate motion that caused this movement.	• given sonar maps of the Pacific and Atlantic oceans, justify how plate movement caused the differences in some of the ocean features over time.
• given a diagram of the hydrological cycle, justify how solar energy or Earth's gravity drives the motion within this cycle.	• given a diagram of a rock cycle, explain the processes that cause one rock to transform into another rock type.	• given a scenario about a volcanic eruption, explain the possible pathways for lava to transform into a sedimentary rock.
• given a Carboniferous period map of Pennsylvania, locate where coal fields are mostly likely to currently be found.	• given a diagram of the hydrological cycle, justify how solar energy and Earth's gravity drive the motion within this cycle.	• given a data set that shows fluctuation in solar energy over a given period of time, explain the effects this could have on the hydrologic cycle.
• given a comparative graph that shows the latitude of various locations and their annual average temperature, identify various regional climates.	• given a map of Pennsylvania during the Carboniferous period and another that shows Pennsylvania’s current coal fields, use geologic evidence to justify why coal is not evenly distributed across Pennsylvania.	• given a map of the United States during the Carboniferous period and another that shows the current coal fields across the United States, use geologic evidence to rank where the largest and smallest coal mines should be located across the United States.
• given an isobaric map of a region, determine the type of weather that region is experiencing.	• given a comparative graph that shows the latitude of various locations and their annual average temperature, determine various regional climates.	• given a comparative graph that shows the latitude and longitude of various locations and their annual average temperature along with a map of the global oceanic surface currents, justify the locations of various global climate regions.
• given a graph over the last 100 years that compares carbon dioxide levels to average global temperature levels, identify at least one possible natural or human caused reason for the change over time.	• given various labeled isobaric maps of a region over given period of time, predict the type of weather that the mapped region may experience.	• given a labeled isobaric and isothermal map over a given period of time, predict the type of precipitation and wind speed that region may experience.
• given a seismograph of activity prior to, during and after a major volcanic eruption, identify when the eruption occurred.	• given a graph over the last 100 years that compares carbon dioxide levels to average global temperature levels, identify at least one possible natural and human caused reason for the change over time.	• given a graph over the last 100 years that compares carbon dioxide levels to average global temperature levels, extrapolate what the pattern would possibly look like in another 100 years and justify this response.
• given a scenario where a dam is designed and built to provide hydroelectric energy to a community, design a method to test the quality of water.	• given a seismograph of activity prior to, during and after a major volcanic eruption, justify why the eruption was likely to occur.	• given a seismograph of activity prior to, during and after a major volcanic eruption, design a type of early warning system to predict future eruptions.

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Basic	**Proficient**	**Advanced**
• given a graph that compares human population of a region over a finite amount of time to the amount of green space in the region, identify how the change in population impacted the region.	• given a scenario where a dam is designed and built to provide hydroelectric energy to a community, design a method to test the quality of water to determine the impact the new dam has on the community.	• given a scenario where a dam is designed and built to provide hydroelectric energy to a community, design a method to test the quality of water and suggest possible mitigation actions that might need to be taken to ensure the water quality stays high.
• given three sources, write instructions to use and maintain a technological product or system.	• given a graph that compares human population of a region over a finite amount of time to the amount of green space in the region, justify how the change in population impacted the region.	• given a graph that compares human population of a region over a finite amount of time to the types of resources in the region, justify how the change in population impacted the region.
• given an everyday product, like a battery, select the appropriate instrument and properly utilize that instrument to gather data and communicate the data properly.	• given three sources, develop a user manual to operate and maintain a technological system (e.g., a circuit board, a coffee maker, a navigation system, a microwave).	• given three sources, develop a user manual detailing step-by-step instructions to operate, maintain, and optimize the performance of a technological product or system.
• identify an historical example of a technology leading to individual, cultural, social and/or environmental upheaval.	• be able to graph battery life with the appropriate instruments to properly communicate the performance of a battery in a technological device.	• use instruments to gather and evaluate battery life data to demonstrate which battery performs the best given a set of performance criterion.
• using a provided graphic organizer, identify key inputs and outputs and their positive or negative environmental impacts.	• describe how history may have changed had a different technology been selected at critical junctures in history (e.g., had the atomic bomb not been used).	• hypothesize and use evidence-based arguments to defend how history may have changed had different decisions involving technology been made at critical junctures in history.
• in a given design challenge, recognize that waste is often created from technological processes.	• create a diagram to show inputs and outputs of technological systems and their possible environmental impacts. Example, using the universal systems model to identify the inputs and outputs of operating a gasoline automobile while indicating positive or negative environmental impacts.	• model a technological system that identifies inputs and outputs and develop a plan to mitigate the negative environmental impacts.
• provide an example of technology and elaborate on how that technology has impacted the way people think, interact, live and communicate.	• in a given design challenge, analyze how to reduce the amount of waste that can be created from technological processes.	• in a given design challenge, propose ways to minimize waste that is created as a result of a technological process.
• given the timeline for the creation and evolution of an invention or innovation over time, explain why it was invented and why it was manufactured or produced at that particular time based on constraints.	• given a scenario of impactful technology (e.g., smartphones, Internet), compare the impacts of that technology on the ways that the people in two communities think, interact and communicate, and analyze why the technology might be more appropriate for one society but not the other.	• make judgements and use evidence to justify whether a given emerging technology is the most optimal solution to a given problem.
• given a scenario of a community that is purposing new technology (to put in a wind farm), identify some of the possible	• given the timeline for the creation and evolution of an invention or innovation (e.g., the internal combustion engine, a refrigerator, light bulbs) over time, determine why it was invented and identify at least one problem it solved.	• given the timeline for the creation and evolution of an invention or innovation over time, determine why it was invented, identify at least two problems it solved, and discuss how the design improved over time to serve additional applications.

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Basic	Proficient	Advanced
trade-offs and some of the possible compromises that must occur.	• given a scenario of a community that is purposing a new technology (to put in a wind farm), identify some of the possible trade-offs and compromises that must occur and prioritize them according to the community's needs.	• given a scenario of a community that is purposing new technology (to put in a wind farm), identify some of the possible trade-offs and compromises that must occur and create an implementation plan that addresses the community's needs.
• given a list of technological devices and impacts, classify the impacts as positive or negative.	• determine both positive and negative effects of the evolution of a technological device (e.g., cellular phone, modern plumbing) over time.	• make predictions about the positive and negative effects of rapidly evolving technological devices.
• given a scenario of a malfunctioning system and a bank of possible solutions, fill in the graphic organizer with all of the needed tools and procedures needed to repair the system.	• given a scenario, safely determine the proper tools needed and develop a plan of action for diagnosis and conducting the repair (e.g., the refrigerator is not receiving power and therefore does not turn on).	• create a plan of action including all needed tools and materials to repair multiple problems within the same technological system.
• identify input and output devices within a system.	• compare input and output devices and explain the appropriate application when solving a problem.	• develop and/or construct a solution to a given challenge using effective input and output devices such as sensors.
• list which variables are relevant and what tools are necessary to collect when examining a technological system.	• design a process using identified tools and variables to collect key data on the operation of a technological system.	• implement a process, gather and interpret data on the operation of a technological system.
• using initial data from a prototype of a new product, identify an issue or fault with the prototype and suggest a method for improving the design.	• given a prototype of a new product, develop a possible way to improve the product and create a model for gathering iterative data to justify their modifications.	• given a prototype of a new product, analyze data, create a model for improving and iteratively testing the new design, and use this data to propose an optimal design of the object, tool, or process.
• given various data sets for similar designs, utilize features of each design to generate a new design.	• given various data sets for similar designs, evaluate the best design features of a design and generate a new design that incorporates the best features of all the designs.	• design tests and analyze data to evaluate similar designs that reflect the similarities and differences between the designs and generate a final design that incorporates the best features of all the designs.
• given various scenarios, identify which source of information collected is the most accurate.	• given a scenario that explains multiple ways data were collected (e.g., measure weather), justify which method provided the most accurate data.	• given a scenario that explains multiple ways data were collected (e.g., weather conditions), provide an additional method of accurate data collection that could be used.
• given competing design solutions, use predetermined criteria and tools for evaluation to measure how well each of the solutions meets the constraints of the problem.	• given competing design solutions, develop a systemic process to determine how well each of the solutions meets the constraints of the problem.	• create competing design solutions and develop a systemic process to determine how well each of the solutions meets the constraints of the problem.
• recognize that the technology and engineering design process will aid in successfully solving problems and is an iterative process. • identify a problem and a possible technology to solve that problem.	• explain and apply each step in the iterative technology and engineering design process.	• design and create solutions by using an iterative technology and engineering design process.

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Basic	**Proficient**	**Advanced**
• evaluate competing designs and illustrate benefits of one design over others for an intended use.	• describe in detail a specific adaptation to an existing product or system and elaborate on how that adaptation or system solves a problem.	• display and communicate how changes or innovations to a technological system solve a problem while providing a list of tradeoffs.
• given a simple design problem and human factors related to that problem, propose a solution to the design problem.	• evaluate competing designs, select an optimal design and illustrate its benefits and opportunities, and communicate the advantages of one design over others for an intended use.	• develop a system to evaluate competing designs, select an optimal design and illustrate its benefits and opportunities, and communicate the advantages of one design over others for an intended use.
• given possible design solutions, describe the strengths and weaknesses of the solutions.	• given a design problem (e.g., waste management, plastic pollution), research and identify human factors related to that problem and create viable solutions to the problem.	• identify a design problem then research and evaluate human factors related to that problem and create viable solutions to the problem.
• evaluate older technologies against an updated set of design criteria and determine which systems need an innovative redesign to address most of the new concerns and tradeoffs associated with optimization.	• given a scenario, evaluate and assess the strength and weakness of a given design and provide support for the decision.	• given a list of parameters, create a solution to a given problem and weigh the strengths and weaknesses of the required parameters.
• given a specific design problem, identify some criteria and constraints that lead to possible solutions.	• given an existing technology and its current impacts to society including the global environment, redesign a system to address specified criteria and constraints and recognize tradeoffs associated with optimization.	• identify and redesign an older technology to address modern challenges and use a checklist to determine its shortfalls and develop a solution that addresses areas of needed improvement and tradeoffs associated with optimization.
• identify important criteria to consider during the design of a solution.	• given a specific design problem, define criteria and constraints that lead to possible solutions and limitations to solutions.	• given specific criteria and constraints, investigate potential impacts on a solution and make proposals leading to the best possible solution.
	• use evidence-based arguments to support and defend their design decision using the collective set of criteria through the display and communication of a model.	• use evidence-based (e.g., data, research) arguments while prioritizing tradeoffs and recognizing valuable elements from other designs in the support and defense of their chosen design solution.
• given a text or other source of information about a technological system, identify and compare the overlaps between the contributions of science, technology, engineering and math in that system.	• given a text or other sources of information about a technological system; identify, compare and contrast the overlaps between the contributions of science, technology, engineering and math in that system.	• given a text or other source of information about a technological system; identify, compare, and contrast the overlaps between the contributions of science, technology, engineering and math in that system and discuss how each area impacted the development and design of that system.
• after researching a technological system, analyze and identify the impact on one of the following systems: economic, environmental or social.	• after researching a technological system (e.g., waste management, nuclear power plant), analyze the impact on each of the following systems: economic, environmental and social systems.	• after researching a technological system, evaluate and predict the interconnected impacts on each of the following systems: economic, environmental and social systems.

Pennsylvania Science Grade 8 Performance Level Descriptors

Basic	Proficient	Advanced
• given a limited selection of existing products and a limited series of problems, adapt and apply the products to solve a selected problem(s) in a different setting(s).	• given a simple everyday object (e.g., toothbrush, empty soda bottle, empty cereal box), identify an alternate application for that object to apply the problem in a different setting (e.g., using a cereal box to organize old magazines).	• utilizing existing products, systems, or processes; identify alternate applications or solutions to problems in different settings (e.g., using a cereal box to organize old magazines).
• given a set of technological devices, diagram how these are interrelated and how they link to other subjects/disciplines (e.g., how radar can be used in many ways in many disciplines like navigation, weather, sports, and can be derived from marine mammal/bat echolocation adaptations).	• diagram and explain how information and advancements in seemingly unrelated fields of study influence the creation of new technologies to fulfill human wants and needs (e.g., explain how humans' drive for entertainment perpetuates the computer graphics evolution).	• use knowledge gained from other subject areas to design a product or technological system to solve a problem within a given unrelated field (e.g., use understanding of paint colors to develop a small batch paint mixer for middle school art classes).
• given historical data about a technology, explain why that technology developed during a particular region or time period,	• use research and evaluate data about a technology (e.g., topographical map of a geographic area) to explain why that technology developed during a particular region or time period.	• use research and evaluate data to predict which technology could be developed in a particular region or during a specific time period.
• given a timeline of a technological development, identify evidence elaborating how the technology has changed over time to become more efficient and effective at addressing a human want or need.	• given a timeline of a technological development, use evidence-based arguments to defend how the technology has changed over time.	• given a timeline of technological developments, develop a model to hypothesize/extrapolate how the technology will continue to change and evolve with time to grow more efficient and effective at addressing a human want or need.
• given a diagram of a technological system, identify one of each of the inputs, outputs, processes, and feedback that allow that system to function.	• given a diagram of a technological system (e.g., a car's fuel system, a home heating system), identify each of the inputs, outputs, processes, and feedback that allow that system to function.	• given a diagram of a technological system, identify each of the inputs, outputs, processes, and feedback that allow that system to function and discuss how each component contributes to the functioning of the system as a whole.
• identify the various parts of an entire system as they relate to the whole to draw basic conclusions regarding how the system functions in the environment.	• analyze a system to identify and differentiate the various parts of the entire system as they relate to the whole to draw conclusions regarding how the system interacts within the environment it is used.	• analyze a system to identify and differentiate the various parts of the entire system as they relate to the whole to predict how the system can better interact within its environment or related to another system to reduce negative impacts.
• when presented with various diagrams of open and closed-loop systems, identify the system that is an open-loop system.	• when presented with the necessary equipment (e.g., wire, bulb, switch, power source), create a diagram of an open-loop system with the equipment that requires human intervention to cause the system to function.	• when presented with the necessary equipment (e.g., wire, bulb, switch), create a diagram of an open-loop system using the equipment, while labeling the necessary components, that requires human intervention to cause the system to function.
• when presented with various diagrams of open and closed-loop systems, identify the system that is a closed-loop system and the feedback that the system receives within the closed-loop system that requires no human interaction.	• when presented with the equipment necessary (e.g., heat exchanger, controls, supply and return lines, circulator pump), create a diagram of a closed-loop system with feedback labeled that does not require human intervention.	• when presented with the equipment necessary (e.g., heat exchanger, controls, supply and return lines, circulator pump), create a diagram of a closed-loop system using the equipment, while labeling and describing the flow and feedback of the system that does not require human intervention.

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Pennsylvania Science Grade 8 Performance Level Descriptors		
Basic	**Proficient**	**Advanced**
• given a description of a possible future technological advancement, describe two outcomes of the introduction of that technology, one of which would be a possible unintended consequence that is unrelated to the technology's intended purpose.	• given a description of a possible future technological advancement, describe three outcomes of the introduction of that technology, one of which would be a possible unintended consequence that is unrelated to the technology's intended purpose.	• given a description of a possible future technological advancement, describe three outcomes of the introduction of that technology, two of which would be possible unintended consequences that are unrelated to the technology's intended purpose.
• given the description of an everyday object, describe an improvement to that product that either makes it more efficient, better performing, or having a lower environmental impact and then identify how this could be tested to determine if the improvement was effective.	• given the description of an everyday object (e.g., car, truck, refrigerator, dishwasher), develop and describe an improvement to that product that either makes it more efficient, better performing, or having a lower environmental impact and then describe how this could be tested to determine if the improvement was effective.	• given the description of an everyday object, develop and describe an improvement to that product that either makes it more efficient, better performing, or having a lower environmental impact and then formulate a test to determine if the improvement was effective.
• given information or a diagram with specifications about a technology, recognize how innovation either comes from creativity or by accident, after identifying conclusions from technical information presented regarding unintended innovations.	• given multiple sources of information containing diagrams with specifications about a technology (e.g., Kevlar, Velcro), explain how innovation either comes from creativity or by accident, after drawing conclusions from technical information presented regarding unintended innovations.	• given multiple sources of information containing diagrams with specifications about a technology, formulate an innovation that can come from creativity or by accident, after drawing conclusions from technical information presented regarding unintended innovations.
• given multiple technologies, identify the necessary processes that must happen for the new product to be introduced to consumers.	• given multiple technologies, (e.g., creating a new online search engine, making a new smartphone in a factory), compare the necessary processes that must happen for the new product to be introduced to consumers.	• given multiple technologies, compare then formulate the necessary differentiated processes that must happen for the new product to be introduced to consumers.

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