Content Area: Science
Grade: 8

Unit	Enduring Understandings	Essential Questions	Objectives	Skills
Harnessing Human Energy -Launch Unit	Students will understand that: Whenever something moves or changes, it is because of energy. When something is moving, it has kinetic energy. When something has the ability to make things move or change in the future, it has potential energy, even if it is not moving or changing now. Nothing creates energy. If something has energy, the energy must have been transferred from something else. Energy can be transferred from one object to another, and energy can be converted from one type to another. The amount of energy that a solution can provide must be taken into consideration.	How can rescue workers get energy for their equipment during rescue missions? Chapter 1: What is energy and why does it matter to the rescue team? Chapter 2: How can the rescue workers get energy to the batteries in their equipment during rescue missions? Chapter 3: What is the best way for the rescue workers to capture energy from their bodies' motion during rescue missions?	Whenever something moves or changes, it is because of energy. (1.2) When something is moving, it has kinetic energy. (1.3) When something has the ability to make things move or change in the future, it has potential energy, even if it is not moving or changing now. (1.3) Nothing creates energy. If something has energy, the energy must have been transferred from something else. (2.2) Energy can be transferred from one object to another, and energy can be converted from one type to another. (2.2)	Plan and carry out investigations Develop models Analyze data Interpret data Generate questions Obtain information Construct explanatory conclusions Evaluate Write an Argument

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Force and Motion	Progress Build Level 1: A force causes a change in an object's velocity. When an object experiences a force, its velocity will change, depending on the strength and direction of the force. A stronger force causes a greater change in an object's velocity. Progress Build Level 2: An object's mass determines its velocity change for a given force. When an object experiences a force, its velocity will change, depending on the strength and direction of the force. A stronger force causes a greater change in an object's velocity. However, if two objects of different mass experience the same force for the same amount of time, the less massive object will have a greater change in velocity. Progress Build Level 3: When two objects collide, both experience the same strength force, but in opposite directions. When an object experiences a force, its velocity will change, depending on the strength and direction of the force. A stronger force causes a greater change in an object's velocity. However, if two objects of different mass experience the same force for the same amount of time, the less massive object will have a greater change in velocity. If two objects collide, each object exerts a force on the other that is equal in size, but in the opposite direction. If those two objects have different masses, the less massive object will have a greater change in velocity.	What happened in the missing seconds when the space pod should have docked with the space station? Chapter 1: What caused the pod to change direction? Chapter 2: The thrusters on the ACM pod exerted the same strength force as thrusters on other pods, so why did this pod move differently? Chapter 3: After the collision, how does the pod's motion compare to the motion of the space station? Chapter 4: Students apply what they learn to a new question—Why did Vehicle 2 fall off the cliff in Claire's test of the collision scene, but Vehicle 2 did not fall off the cliff in the film Iceworld Revenge?	A force is required to change the velocity of an object. (1.3) How an object changes velocity depends on the direction of the force exerted on that object. (1.3) A stronger force can cause a greater change in velocity. (1.5) Understanding a cause-and-effect relationship can help you infer what led to a particular result. (1.6) If the same strength force is exerted on two objects but the objects have different masses, the object with less mass will have a greater change in velocity. (2.3) When two objects collide, a force is exerted on each object. The two forces are exerted in opposite directions, but they are the same strength. (3.2) Even though the force exerted on each object in a collision is the same strength, if the objects have different masses, their changes in velocity will be different. (3.3)	Plan and carry out investigations Develop models Analyze data Interpret data Generate questions Obtain information Construct explanatory conclusions Evaluate Write an Argument

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Force and Motion Engineering Internship	Engineers design plans, physical objects, and processes that try to solve human problems. Criteria define the engineering problem. When an object falls and hits the ground, a collision occurs. The ground exerts a force on the object, and the object exerts a force on the ground. These are called impact forces. After impact with the ground, the velocity of the pod changes to zero. Collisions involve a force acting between the objects for some amount of time. Increasing the time over which a collision occurs can decrease the damage to an object because it spreads out the force over a longer period of time. Scientific knowledge is constrained by human capacity, technology, and materials. Engineers need to understand the problem they are trying to solve so they can design an effective solution. Engineers sometimes use models to test their designs. Three factors affect the size of the forces when two objects hit each other: how long the collision lasts, the velocity on impact, and the mass of each object. Engineers read with purpose to understand relevant background information that impacts their work. Analyzing a design's function can inform revisions to its structure. Models have limitations because they are often simplified. Modifications are made to a design based on the evaluated results; the design is modified in order to be tested again. This is called an iteration. Engineers take feedback into consideration during the iterative process (modifying the design at each iteration). For optimal designs, engineers complete several iterations, often combining the best parts of previous designs. Engineers consider trade-offs by weighing the impact of each criterion against the others. Trade-offs may make it difficult or impossible to meet all the criteria for a design project. Strong engineering proposals use evidence to describe why the design is optimal, including a discussion of trade-offs and comparisons to earlier iterations. An engineer's written proposal explains to others how and why a design solution works. One kind of collision involves objects being pulled to Earth by gravity and hitting the ground. Strong proposals are written for a professional audience and use topic-specific vocabulary words. Engineers improve the use of evidence and the professionalism of their writing when they revise their written proposals. Solutions to a problem will differ based on the defined criteria. Mechanical engineers can use The Design Cycle to offer solutions to many problems beyond supply pod designs.	How can we design delivery pods that are damaged as little as possible when dropped?	Design Problem: Design a supply drop pod for areas affected by natural disaster. Design Problem: Design a container that minimizes damage to an egg in a fall.	Plan and carry out investigations Develop models Analyze data Interpret data Generate questions Obtain information Construct explanatory conclusions Evaluate Write an Argument

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Magnetic Fields	Progress Build Level 1: Magnetic fields exert force from a distance that can repel like poles or attract opposite poles. Magnetic force can act at a distance to make objects move. In a system of magnets, there is a repelling force between like poles and an attracting force between opposite poles. Progress Build Level 2: Potential energy is stored in a system when a magnet is moved against magnetic force. Magnetic force can act at a distance to make objects move. In a system of magnets, there is a repelling force between like poles and an attracting force between opposite poles. The energy used to move a magnet against a magnetic force is stored as potential energy in the magnetic field. This magnetic force can convert potential energy stored in the magnetic field to kinetic energy. Progress Build Level 3: Moving a magnet against a stronger magnetic force transfers more energy to the magnetic field. Magnetic force is stronger closer to a magnet. Magnetic force can act at a distance to make objects move. In a system of magnets, there is a repelling force between like poles and an attracting force between opposite poles. The energy used to move a magnet against a magnetic force is stored as potential energy in the magnetic field. Magnetic force is stronger closer to a magnet, so it takes more energy to move against magnetic force closer to a magnet. This magnetic force can convert potential energy stored in the magnetic field to kinetic energy.	Why did the tests of a magnetic spacecraft launcher not go as planned? Chapter 1: How can the launcher make the model spacecraft move without touching it? Chapter 2: Where did the energy to launch the model spacecraft come from? Chapter 3: Why was there so much more potential energy stored in the launcher system on Wednesday than on Tuesday? Chapter 4: Students apply what they learn to a new question—Which design will launch the roller coaster car the fastest?	A magnetic force can attract or repel an object at a distance. (1.2) In a system of magnets, there is a repelling force between like poles and an attracting force between opposite poles. (1.3) The pattern of magnetic field lines around attracting magnets is different from the pattern of magnetic field lines around repelling magnets. (1.5) A magnetic force can convert potential energy stored in a magnetic field to kinetic energy. (2.2) The energy used to move a magnet against a magnetic force is stored as potential energy in the magnetic field. (2.3) Creating a model of a magnetic system and defining its parts helps scientists test and explain the relationship between force and energy. (2.4) Moving a magnet against a stronger magnetic force transfers more energy to the magnetic field. (3.2) A magnetic force is stronger closer to a magnet. (3.2)	Plan and carry out investigations Develop models Analyze data Interpret data Generate questions Obtain information Construct explanatory conclusions Evaluate Write an Argument

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Light Waves	Progress Build Level 1: Light carries energy that can be absorbed by a material, causing the material to change. Light carries energy. When light hits a material, this energy can be absorbed by the material, which transfers the energy into the material and causes the material to change in some way. Progress Build Level 2: Different types of light can change a material in different ways; a material can absorb energy from some types of light but not others. Light carries energy. When light hits a material, this energy can be absorbed by the material, which transfers the energy into the material and causes the material to change in some way. There are different types of light. These different types of light can change the same material in different ways, and a material can absorb the energy from certain types of light but not others. A single light source can give off more than one type of light. Progress Build Level 3: Light can be absorbed, reflected, or transmitted by a material; if the light is reflected or transmitted, the energy is not absorbed and the material will not change. Light carries energy. When light hits a material, this energy can be absorbed by the material, which transfers the energy into the material and causes the material to change in some way. There are different types of light. These different types of light can change the same material in different ways, and a material can absorb the energy from certain types of light but not others. A single light source can give off more than one type of light. Light travels in a straight line. When different types of light hit a material, they can be absorbed by the material, transferring energy to the material; they can reflect off of the material; or they can transmit through the material. When light is transmitted through or reflected off a material, the energy is not absorbed, so the material does not change. A material can absorb, reflect, or transmit certain kinds of light but not others	Why is there a higher rate of skin cancer in Australia than in other parts of the world? Chapter 1: How does light from the sun cause skin cancer? Chapter 2: How can the same amount of sunlight cause different rates of skin cancer? Chapter 3: Why does Australia get more ultraviolet light than other parts of the world? Chapter 4: Students apply what they learn to a new question—Can the crabs see the plankton they eat near the ocean floor?	The movement of energy can be tracked by observing the changes the energy causes to matter. (1.2) Light carries energy that causes materials to change. (1.2) When light hits a material, the material can absorb energy from the light. (1.3) When a material absorbs energy from light, the energy causes the material to change. (1.3) There are different types of light that can change a material in different ways. (2.2) A light source can emit more than one type of light. (2.3) Different types of light have different wavelengths. (2.3) A material absorbs energy from some types of light and not others. (2.4) Light travels in a straight line. (3.1) When a light wave hits a material, the light can be absorbed by the material, transmitted through the material, or reflected off the material. (3.1) A material transmits or reflects some types of light and not others. (3.2) When light is transmitted through or reflected off a material, the energy is not absorbed, so the material does not change. (3.3)	Plan and carry out investigations Develop models Analyze data Interpret data Generate questions Obtain information Construct explanatory conclusions Evaluate Write an Argument

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Earth, Moon, and Sun	Progress Build Level 1: We see the Moon because the sun illuminates the half of the Moon that is facing it. The Moon does not make its own light; we can see the Moon because the sun illuminates it. Since light travels in straight lines, the sun is always illuminating the half of the Moon that faces it, and the other half of the Moon is dark. Progress Build Level 2: The Moon's repeating cycle of phases is caused by the Moon's changing position in its orbit around Earth. The Moon does not make its own light; we can see the Moon because the sun illuminates it. Since light travels in straight lines, the sun is always illuminating the half of the Moon that faces it, and the other half of the Moon is dark. The Moon is always orbiting around Earth in a circle, and from Earth we can only see the half of the Moon that is facing Earth. As the Moon's orbital position changes, the portion of the illuminated half of the Moon that we can see from Earth also changes. This changing orbital position, which affects the relative positions of Earth, the Moon, and the sun, is what causes the phases of the Moon that we see. Since the Moon's orbit repeats in a predictable pattern, about once a month, the phases of the Moon that we see also follow a predictable monthly pattern. Progress Build Level 3: Lunar eclipses happen during relatively rare moments when the sun, Earth, and the Moon are perfectly aligned. The Moon does not make its own light; we can see the Moon because the sun illuminates it. Since light travels in straight lines, the sun is always illuminating the half of the Moon that faces it, and the other half of the Moon is dark. The Moon is always orbiting around Earth in a circle, and from Earth we can only see the half of the Moon that is facing Earth. As the Moon's orbital position changes, the portion of the illuminated half of the Moon that we can see from Earth also changes. This changing orbital position, which affects the relative positions of Earth, the Moon, and the sun, is what causes the phases of the Moon that we see. Since the Moon's orbit repeats in a predictable pattern, about once a month, the phases of the Moon that we see also follow a predictable monthly pattern. During the part of the Moon's orbit when Earth is in between the sun and the Moon, we usually see a full moon. However, during some full moons, the relative positions of the sun, Earth, and the Moon align so that they create a straight line, with Earth in the middle. When this happens, Earth blocks the sun's light from reaching the Moon, and we see a lunar eclipse. An eclipse does not happen during every full moon because often the Moon is either slightly above or slightly below this straight line	Chapter 1: Why is there a border between light and dark on the Moon? Chapter 2: Why does the border between light and dark on the Moon change location? Chapter 3: What are the conditions that cause a lunar eclipse? Chapter 4: Students apply what they learn to a new question—During a year, will there be a lunar eclipse of the moon of Kepler-47c?	The Moon does not make its own light; the sun illuminates the Moon. (1.2) When a model is "to scale," object sizes and distances are larger or smaller than in the real world but the same relative to one another. Some models need to be "not to scale" to be useful. (1.3) The sun illuminates the half of the Moon that is facing it, and the other half is dark. (1.4) From Earth we can only see the half of the Moon that is facing us. (2.3) Because the Moon moves to different positions around Earth, we see different amounts of the illuminated half of the Moon. This is why we see different phases of the Moon. (2.3) Light from the sun travels in straight lines. (1.4) During a lunar eclipse, the Moon is completely dark because Earth blocks sunlight from hitting the Moon. (3.1) Lunar eclipses can only happen when Earth is in between the sun and the Moon. (3.1) Lunar eclipses do not happen every time Earth is in between the sun and the Moon. (3.3) The Moon is only completely dark when the sun, Earth, and the Moon are in a straight line, with Earth in the middle. (3.3)	Plan and carry out investigations Develop models Analyze data Interpret data Generate questions Obtain information Construct explanatory conclusions Evaluate Write an Argument

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Natural Selection	Progress Build Level 1: Adaptive traits become more common while traits that are non-adaptive become less common in a population over many generations. Populations change because individuals with certain traits are more likely to survive in a particular environment than individuals with other traits. Given factors in the environment that affect which traits are more likely to survive, adaptive traits will become more common in the population over time. If the adaptive trait isn't present in the starting population, it cannot become more common over time. Changes in the environment cause changes to the distribution of traits in a population. Progress Build Level 2: Individuals with adaptive traits are more likely to live longer and pass on those traits to their offspring. Populations change because individuals with certain traits are more likely to survive in a particular environment than individuals with other traits. Given factors in the environment that affect which traits are more likely to survive, adaptive traits will become more common in the population over time. If the adaptive trait isn't present in the starting population, it cannot become more common over time. Changes in the environment cause changes to the distribution of traits in a population. Individuals with adaptive traits are more likely to live longer and have offspring; individuals with non-adaptive traits are more likely to die without having offspring. Offspring inherit traits from their parents. Over many generations, adaptive traits become more common because more of those individuals live long enough to reproduce. Over many generations, non-adaptive traits become less common because fewer individuals with those traits survive and reproduce. Progress Build Level 3: Mutations can sometimes introduce new traits into a population. Populations change because individuals with certain traits are more likely to survive in a particular environment than individuals with other traits. Given factors in the environment that affect which traits are more likely to survive, adaptive traits will become more common in the population over time. If the adaptive trait isn't present in the starting population, it cannot become more common over time. Changes in the environment cause changes to the distribution of traits in a population. Individuals with adaptive traits are more likely to live longer and have offspring; individuals with non-adaptive traits are more likely to die without having offspring. Offspring inherit traits from their parents. Over many generations, adaptive traits become more common because more of those individuals live long enough to reproduce. Over many generations, non-adaptive traits become less common because fewer individuals with those traits survive and reproduce. Occasionally, an individual is born with a mutation, introducing a new trait into a population. If the mutant trait is helpful for survival, the offspring of that individual are more likely to survive and become more common. Mutant traits that are non-adaptive do not become more common in a population.	Chapter 1: What caused this newt population to become more poisonous? Chapter 2: How did the trait for increased poison level become more common in the newt population? Chapter 3: How did a poison-level trait that wasn't always present in the newt population become the most common trait? Chapter 4: Students apply what they learn to a new question—What caused the stickleback population to have less armor and become faster?	A population can be described by the traits present and by the number of individuals who have each trait. (1.3) The number of individuals with each trait in a population can change over time. (1.4) Over many generations, individuals with adaptive traits become more common in a population, while individuals with non-adaptive traits become less common. (1.4) The traits that exist in a population determine which traits can become more common over many generations. (1.4) Whether or not a trait is adaptive depends on the environment. (1.5) Biologists analyze data about environmental conditions (the causes) to explain changes in the distribution of traits in populations (the effects). (1.6) Genes are instructions for making protein molecules and protein molecules determine an organism's traits. (2.2) Individuals inherit their genes from their parents. Genes, and therefore traits, in a population are passed down from generation to generation. (2.2) Individuals with adaptive traits are more likely to live longer and have offspring; individuals with non-adaptive traits are more likely to die without having offspring. (2.4) Mutations are changes to genes that can lead to changes to protein molecules, which can result in changes to traits. (3.2) Mutations to genes can sometimes introduce new traits into a population. (3.2) A new trait will only become more common in a population if it is adaptive. (3.3)	Plan and carry out investigations Develop models Analyze data Interpret data Generate questions Obtain information Construct explanatory conclusions Evaluate Write an Argument

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Natural Selection Engineering Internship	Engineers design plans, physical objects, and processes that try to solve human problems. Criteria define the engineering problem. Malaria is caused by microscopic parasites called Plasmodium As a result of natural selection, some populations of malaria parasites are becoming resistant to certain antimalarial drugs. Scientific knowledge is constrained by human capacity, technology, and materials. Engineers need to understand the problem they are trying to solve so they can design an effective solution. Engineers read with purpose so they can understand relevant background information that impacts their work. Natural selection occurs in populations we can see, & also in populations that are too small to see . Antimalarial drugs act as a selection pressure on a population of malaria parasites. When a mutation occurs that leads to a trait for drug resistance, those individuals with these traits will be more likely to survive the exposure to that drug and be able to reproduce and pass this trait to their offspring. This shifts the distribution of traits in that population, so that many more individual parasites have resistance for that drug. Engineers sometimes use models to test their designs. Models have limitations because they are often simplified. Using a single-drug treatment results in the distribution of traits in a malaria population shifting towards having more resistance to the drug used in that treatment. Once there is resistance to a drug, that drug may no longer effectively treat malaria. A key strategy for experimental design is isolating variables. Many drugs have patient side effects, which can interfere with an effective drug treatment. Different antimalarial drugs have different characteristics. Modifications are made to designs based on evaluated results. Designs are modified in order to be tested again. Engineers consider trade-offs by weighing the impact of each criterion against the others. Combinations of drugs are most effective at minimizing the traits for resistance. People from different social, cultural, and ethnic backgrounds work as scientists and engineers. Advances in technology influence the progress of science and science has influenced advances in technology. Science knowledge can describe consequences of actions but is not responsible for society’s decisions. Results are evaluated based on how they address the criteria. Engineers take feedback into consideration during the iterative process (modifying the design at each iteration). For optimal designs, engineers complete several iterations, often combining the best parts of previous designs. Trade-offs may make it difficult or impossible to meet all the criteria for a design project. Strong engineering proposals use evidence to describe why the design is optimal, including a discussion of trade-offs and comparisons to earlier iterations. An engineer's written proposal explains to others how and why a design solution works. Strong proposals are written for a professional audience and use topic-specific vocabulary words. Engineers improve the use of evidence and the professionalism of their writing when they revise written proposals. Solutions to a problem will differ based on the defined criteria. Biomedical engineers develop devices and medicines to help address health issues.	How can we design treatments for malaria that don’t lead to drug resistance?	Design Problem: Design a malaria treatment that minimizes drug-resistant malaria. Investigative Phenomenon: Some parasites build resistance to a given antimalarial drug, and some do not. Design Problem: Define a new engineering problem related to reducing malaria without antimalarial drugs.	Plan and carry out investigations Develop models Analyze data Interpret data Generate questions Obtain information Construct explanatory conclusions Evaluate Write an Argument

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Evolutionary History	Progress Build Level 1: Body structures shared between species are evidence that these two species inherited the shared structures from a common ancestor population. Different species can share body structures. When two species share structures, it is evidence that these species may be descended from a common ancestor population that also had those structures. This is because species inherit their body structures from their ancestor populations. Progress Build Level 2: Species that share structures can have differences because they have been in separate environments, and have changed in different ways over time. Different species can share body structures. When two species share structures, it is evidence that these species may be descended from a common ancestor population that also had those structures. This is because species inherit their body structures from their ancestor populations. Although two or more species can share structures, these structures can also have differences. Differences in shared structures may be evidence that these species had a common ancestor population that was separated into different environments, where different changes arose through natural selection as the environments changed over time. Over many generations and very long periods of time (hundreds of thousands to millions of years), the accumulation of these changes can result in different populations having larger differences in their shared structures. Progress Build Level 3: Because populations separate and begin evolving differences at different points in time, similarities and differences in body structures can be used to interpret evolutionary relationships. Different species can share body structures. When two species share structures, it is evidence that these species may be descended from a common ancestor population that also had those structures. This is because species inherit their body structures from their ancestor populations. Although two or more species can share structures, these structures can also have differences. Differences in shared structures may be evidence that these species had a common ancestor population that was separated into different environments, where different changes arose through natural selection as the environments changed over time. Over many generations and very long periods of time (hundreds of thousands to millions of years), the accumulation of these changes can result in different populations having larger differences in their shared structures. Populations separate into different environments at different points over time. The more recently that populations separated, the more recently they shared a common ancestor and the more closely related they are. Body structures that are unique to a group of species but are not shared by other species provide evidence that all species with that structure share a common ancestor that is more recent than the common ancestor they share with the species that do not have that structure	Chapter 1: Where in the museum does this new fossil belong? Chapter 2: How did wolves, whales, and the Mystery Fossil become so different from their common ancestor population? Chapter 3: How can we tell if the Mystery Fossil is more closely related to wolves or to whales? Chapter 4: Students apply what they learn to a new question—Is the Tometti fossil more closely related to ostriches or to crocodiles?	Species inherit their body structures from their ancestor populations. (1.4) Body structures that are shared between two species are evidence that these two species inherited the shared structures from a common ancestor population. (1.4) In populations separated into different environments, natural selection causes different changes to happen to each population. This causes descendant species to end up with differences in their shared structures. (2.3) When the environment is mostly the same over time, body structures stay stable. When the environment changes over time, body structures may change due to natural selection. (2.3) Over many generations and very long periods of time, many small changes can build up to large differences in body structures. (2.4) Among any three species, the two species that separated most recently are the most closely related to each other. (3.1) When two species share a structure that is not shared with a third species, this can be evidence that the first two species are more closely related to each other than to the third species. (3.2)	Plan and carry out investigations Develop models Analyze data Interpret data Generate questions Obtain information Construct explanatory conclusions Evaluate Write an Argument