EAST PENN SCHOOL DISTRICT

Grade 6 Science
DATE OF APPROVAL

Grade 6 Science : Unit 1/2 - Contact Forces and Forces at a Distance

STAGE 1 | DESIRED RESULTS
Context and relevance for student learning

Standards

3.2.6-8.G - Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

3.2.6-8.H - Plan an investigation to provide 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.

3.2.6-8.L - Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

3.1.6-8.H - Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

3.2.6-8.I - Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

Transfer

Students will be able to independently use their learning to...

- ☐ Answer the question, "Why do things sometimes get damaged when they hit each other?"
- ☐ Answer the question, "How can a magnet move another object without touching it?"

Meaning

UNDERSTANDINGS
Students will understand that...

- ☐ All forces between objects, regardless of size or direction, arise from only a few types of interactions.
- ☐ All forces between objects, regardless of size or direction, arise from only a few types of interactions.
- ☐ Forces between objects can result in transfer of energy between these objects.
- ☐ A change in motion of interacting objects can be explained and predicted by forces.
- ☐ A change in motion of interacting objects can be explained and predicted by forces.
- ☐ Energy can be modeled as either motions of particles or as being stored in force fields.

ESSENTIAL QUESTIONS
Students will keep considering...

- ☐ What underlying forces explain the variety of interactions observed?
- ☐ What underlying forces explain the variety of interactions observed?
- ☐ How are forces related to energy?
- ☐ How can one predict an object's continued motion, changes in motion, or stability?
- ☐ What is energy?

Acquisition(need to align with above and standards)

Students will know...
Disciplinary Core Ideas

- ☐ PS2.A. For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).
- ☐ PS2.A. The motion of an object is determined by the sum of the forces acting on it; if the total

Students will be skilled at...
Science and Engineering Practices

- ☐ Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
- ☐ Construct and interpret graphical displays of data to describe the relationships of kinetic

3.2.6-8.K - Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. 3.2.6-8.P - Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.	force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. ☐ PS2.A. All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. ☐ PS2.B: Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). ☐ PS2.B: Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. ☐ PS3.A. Motion energy is properly called kinetic energy ; it is proportional to the mass of the moving object and grows with the square of its speed. ☐ PS3.A: A system of objects may also contain stored (potential) energy, depending on their relative positions. ☐ PS3.B. When the kinetic energy of an object changes, there is inevitably some other change in energy at the same time. ☐ PS3.C. When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. ☐ ETS1.B. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	energy to the mass of an object and to the speed of an object. ☐ Analyze data to determine which materials reduce peak force in a collision and analyze the similarities in the properties of those materials ☐ Develop a model to explain how the changes in the structures of cushioning materials contribute to their function (a reduction in peak forces) at a microscopic level during a collision. ☐ Optimize the performance of a design by prioritizing the particular functions and properties of materials to assess the relative effectiveness of the materials, and engage in quantitative analysis considering trade-offs. ☐ Plan and conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. ☐ Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. ☐ Develop and use a model to explain various phenomena that rely on magnetic forces at a distance using a series of cause-effect relationships.

Grade 6 Science : Unit 3 - Thermal Energy

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.2.6-8.B Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

3.2.6-8.M. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

3.2.6-8.N. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

3.2.6-8.O Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

3.2.6-8.R Develop and use a model to describe that waves are

Transfer

Students will be able to independently use their learning to...

- ☐ Answer the question, “How can containers keep stuff from warming up or cooling down?”

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ All forms of matter exist as a result of the combination or rearrangement of atoms.
- ☐ The total change of energy in any system is always equal to the total energy transferred into or out of the system.
- ☐ Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave pattern of changing electric and magnetic fields that interact with matter.

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ How do particles combine to form the variety of matter one observes?
- ☐ What is meant by conservation of energy?
- ☐ How is energy transferred between objects or systems?
- ☐ What is light?
- ☐ How can one explain the varied effects that involve light?
- ☐ What other forms of electromagnetic radiation are there?

Acquisition(need to align with above and standards)

Students will know...

Disciplinary Core Ideas

- ☐ PS1.A. Structures and Properties of Matter Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.
- ☐ PS3.A. Definitions of Energy The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance)

Students will be skilled at...

Science and Engineering Practices

- ☐ Develop an initial model to describe a phenomenon in which a substance changes temperature and identify structural parts of the system that slow down or speed up the temperature change (function).
- ☐ Plan and carry out investigations to determine the effect of a lid on temperature change and mass change in systems that are more open and less open.
- ☐ Analyze and interpret data by applying concepts of probability to calculate the mathematical mean to compare the temperature change and mass change across conditions (patterns) and use these measures to make claims about the effect of the lid.
- ☐ Develop a model to describe why mass is lost in some conditions but not others (open systems

reflected, absorbed, or transmitted through various materials. MS-ETS1-4.* Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. Temperature is not a measure of energy; the relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. ☐ PS3.B. Conservation of Energy and Energy Transfer When the kinetic energy of an object changes, there is inevitably some other change in energy at the same time. The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. Energy is spontaneously transferred out of hotter regions or objects and into colder ones. ☐ PS4.B. When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.	versus less-open systems), using a particle model of matter for liquids and gases. ☐ Analyze and interpret data from an investigation involving a cold cup system to argue from evidence where the water droplets forming on the outside of the system come from. ☐ Develop and use models to describe what is happening to the particles in the liquid water and how these particles interact with particles in the solid plastic wall. ☐ Construct an explanation about why food coloring moves more in hot water than in cold water using the idea that at the particle scale, particles in liquids at warmer temperatures have more kinetic energy than particles in liquids at cooler temperatures. ☐ Carry out an investigation to look for patterns in data generated by using an interactive simulation of the particles in a gas (which are too small to be observed) to observe the kinetic energy of individual particles and the transfer of energy when they collide. ☐ Analyze and interpret data to mathematically represent the cause-and-effect relationships between the average kinetic energy of the particles of a gas, the temperature of the gas, and the total kinetic energy of all the particles in the gas. ☐ Construct written arguments using evidence from investigations, simulations, videos, and texts to support the claim that energy transfers from hotter objects or regions to colder ones (directionality of energy transfer). ☐ Develop a model based on patterns in performance that can be used to predict ways to minimize or maximize energy transfer into or out of a variety of systems. ☐ Evaluate a design solution that includes several design features (structure) to minimize energy transfer (function) that could result in body heat loss.

Grade 6 Science : Unit 4 - Chemical Reactions & Matter

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.2.6-8.A - Develop models to describe the atomic composition of simple molecules and extended structures.

3.2.6-8.D - Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

3.2.6-8.E - Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

3.1.6-8.H - Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Transfer

Students will be able to independently use their learning to...

- ☐ Answer the question, “How can we make something new that was not there before?”

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ All forms of matter exist as a result of the combination or rearrangement of atoms.
- ☐ The atoms of some substances combine or rearrange to form new substances that have different properties.
- ☐ A change in motion of interacting objects can be explained and predicted by forces.
- ☐ The total change of energy in any system is always equal to the total energy transferred into or out of the system.
- ☐ Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave pattern of changing electric and magnetic fields that interact with matter.

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ How do particles combine to form the variety of matter one observes?
- ☐ How do substances combine or change (react) to make new substances?
- ☐ How does one characterize and explain these reactions and make predictions about them?
- ☐ How can one predict an object’s continued motion, changes in motion, or stability?
- ☐ What is meant by conservation of energy?
- ☐ How is energy transferred between objects or systems?

Acquisition(need to align with above and standards)

Students will know...

Disciplinary Core Ideas

- ☐ PS1.A. Substances are made from different types of atoms, which combine with one another in various ways.
- ☐ PS1.A. Atoms form molecules that range in size from two to thousands of atoms.
- ☐ PS1.A. Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
- ☐ PS1.B. Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances

Students will be skilled at...

Science and Engineering Practices

- ☐ Develop a model showing what is happening at a scale smaller than we can see (patterns) to help explain what happened to the matter in the solid bath bombs (matter) and what caused the gas bubbles to appear (matter).
- ☐ Construct and present an oral and written argument supported by empirical evidence and scientific reasoning to support the claim that gas is not trapped in the bath bomb to start with but must come from some change to the matter that was already in the system to begin with.
- ☐ Analyze and interpret data to identify patterns in the characteristic properties of substances.
- ☐ Plan and carry out an investigation to produce data to serve as the basis for evidence to determine which combinations (patterns) of substances in a bath bomb cause bubbles of gas to appear (effect).

	have different properties from those of the reactants. ☐ PS1.B. The total number of each type of atom is conserved, and thus the mass does not change.	☐ Construct, use, and present an oral and written argument for an explanation that the gas in the bubbles from the bath bomb can be narrowed down to only three possible substances (out of ten of the most common ones in the air) supported by the patterns in the results from density and flammability tests and data on their properties and the use of related key model idea. ☐ Apply key model ideas and patterns in mass and property data to construct three explanations for: a) why the mass of a system decreases when substances are mixed together, b) which substance(s) could or could not be produced in that process, and c) what additional tests could be done on the gas (or other gases) to help identify additional substances that aren't being produced in this process. ☐ Develop and revise a model to predict and describe the unseen interactions between particles in a system to show that matter is conserved in a process where the type of particles that make up the starting substances (system inputs) somehow change through their interactions to make different type(s) of particle(s) in the ending substances (system outputs). ☐ Argue from evidence and critique two arguments on the same topic; strengthen these arguments by using additional empirical evidence (patterns) and scientific reasoning to support an explanation for whether the substances collected from the gas produced by the heated water is made of different types of particles or the same type of particles (patterns) as those in the water that we started with. ☐ Construct an explanation using models of the molecular structures of different substances to predict which gas must be produced (effect) in the bath bomb reaction based on the types of atoms that make up the substances (patterns), and use it to explain what is happening to the particles (matter) in the system to cause the production of this new substance. ☐ Construct an explanation for how the atoms in the molecules of the starting substances rearrange to form new products in the bath bomb, but the number and types of atoms do not change and thus mass is conserved and evaluate two different molecular models for different ratios of reactant and product molecules to determine which better supports this explanation.

Grade 6 Science : Unit 5- Chemical Reactions & Energy

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.2.6-8.F - Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

3.5.6-8.P (ETS) Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

3.5.6-8.N (ETS) Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

3.5.6-8.M (ETS) Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Transfer

Students will be able to independently use their learning to...

- ☐ Answer the question, "How can we use chemical reactions to design a solution to a problem?"

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ The atoms of some substances combine or rearrange to form new substances that have different properties.
- ☐ People should gather, synthesize, and analyze information before drawing conclusions when assessing a technological product, system, or process.
- ☐ Decisions made about technology and engineering involve consideration of costs, benefits, and tradeoffs.

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ How do substances combine or change (react) to make new substances?
- ☐ How does one characterize and explain these reactions and make predictions about them?
- ☐ How can information be used to evaluate technological products, systems and processes?
- ☐ How do costs, benefits, and tradeoffs factor into decisions made about technology and engineering?

Acquisition(need to align with above and standards)

Students will know...

Disciplinary Core Ideas

- ☐ PS1.B. Some chemical reactions release energy, others store energy.
- ☐ ETS1.B. Developing Possible Solution A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. Models of all kinds are important for testing solutions.
- ☐ ETS1.C. Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that

Students will be skilled at...

Science and Engineering Practices

- ☐ Define a design problem that can be solved through the development of a homemade flameless heater with multiple criteria and constraints that uses a chemical process (system 1) to heat up food (system 2).
- ☐ Apply scientific ideas to design a solution for a flameless heater that heats food by a chemical process that transfers energy.
- ☐ Conduct an investigation to serve as the basis for evidence to confirm that the devices are undergoing a chemical reaction when the temperature increases as energy is transferred from the substances in the devices to its surroundings (what the thermometer measures).
- ☐ Develop a model to describe how energy is transferred between different parts of our

	performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.	reaction system to inform the next steps of the design process. ☐ Analyze data to identify patterns in numerical relationships and images to define an optimal proportion of reactants that result in the greatest temperature change and least amount of reactants left over. ☐ Analyze data by identifying patterns to define an optimal operational range for our homemade flameless heater designs that best meets criteria for success because the more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. ☐ Undertake a design project to construct and test a solution that meets specific design criteria and constraints, including the transfer of energy. ☐ Optimize performance of a design that represents systems and energy flows between systems by revising and retesting to incorporate characteristics of the most promising solutions. ☐ Make a written argument that supports or refutes the advertised performance of a sea turtle incubator based on evidence concerning whether the incubator meets relevant criteria and constraints, such as transferring the right amount of energy to the sea turtle eggs.

Grade 6 Science : Unit 6 - Light & Matter, Sound Waves

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.2.6-8.Q - Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

3.2.6-8.R - Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

3.2.6-8.S - Integrate qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.

3.1.6-8.H - Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Transfer

Students will be able to independently use their learning to...

- ☐ Answer the question, “Why do we sometimes see different things when looking at the same object?”
- ☐ Answer the question, “How can a sound make something move?”

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ Waves are repeating patterns of motion that transfer energy and information without transferring matter.
- ☐ Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave pattern of changing electric and magnetic fields that interact with matter.
- ☐ Useful modern technologies and instruments have been designed based on an understanding of waves and their interactions with matter.
- ☐ A change in motion of interacting objects can be explained and predicted by the forces.

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ What are the characteristic properties and behaviors of waves?
- ☐ What is light? How can one explain the varied effects that involve light? What other forms of electromagnetic radiation are there?
- ☐ How are instruments that transmit and detect waves used to extend human senses?
- ☐ How can one predict an object’s continued motion, changes in motion, or stability?

Acquisition(need to align with above and standards)

Students will know...

Disciplinary Core Ideas

- ☐ PS4.A: Wave Properties 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.
- ☐ PS4.B. When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object’s material and the frequency (color) of the light.
- ☐ PS4.B. The path that light travels can be traced as straight lines, except at surfaces between different transparent

Students will be skilled at...

Science and Engineering Practices

- ☐ Construct and revise an explanation using a model to explain why an object appears different (effect) depending on the interaction between light and an object’s material and how the brain processes signals (causes).
- ☐ Apply science ideas and evidence from classroom investigations to explain a common, real-world phenomenon in which a material designed for light transmission and to look transparent to the eye and brain functions as a one-way mirror due to the relationship the material has to other parts in the system.
- ☐ Develop and use a model to explain the observable one-way mirror phenomenon caused by unobservable interactions between light, the people, and the one-way mirror, which reflects and transmits about the same amount of light.

	materials (e.g., air and water, air and glass) where the light path bends ☐ LS1.D. Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.	☐ Develop a model that describes how the eye responds to (interacts with) different inputs of light and transforms those inputs to signals that travel along the optic nerve to the brain, which processes the signals into what we “see.” ☐ Use evidence to modify a model to explain how an object’s material (structure) influences the path of light as it transmits through or reflects off the material (function). ☐ Develop a model to describe the unobservable mechanisms that affect how a material’s microscale structures change how light reflects off and transmits through the material (function). ☐ Analyze and interpret data to identify patterns in the data that provide evidence of the relationship between a force (cause) on an instrument and the motion/vibration (effect) of the instrument. ☐ Develop a model to describe how a force applied to an instrument causes its shape to change, leading it to repeatedly deform above and below its initial position (effect) as it vibrates and use that model to predict what a force will do to another instrument. ☐ Engage in argument from evidence to support or refute our predictions about whether all solid objects vibrate (cause) when they make sounds (effect), even when we cannot see them vibrate." ☐ Use mathematical representations of position versus time graphs generated from a tool used to scale up the vibrations of an object to describe wave patterns and support scientific conclusions about how objects move when they make louder or softer sounds. ☐ Use mathematical representations of position versus time graphs generated from a tool used to scale up the vibrations of an object to describe wave patterns and support scientific conclusions about how objects move when they make higher-pitch and lower-pitch sounds. ☐ Use evidence from investigations to compare and critique competing claims and argue that air or another medium such as liquid or solid is needed (cause) to hear sound or move the window (effect). ☐ Apply mathematical concepts and processes to find and analyze patterns in numerical data and graphs of how the energy transferred by a vibrating object changes in proportion to changes in the amplitude and/or frequency of the object’s vibrations.