Course Title: 7th Grade Physical Science

Department: Science

Grades: 7th Credits: 1

Course Overview/Description

The Little Chute Middle School adopted science curriculum is Amplify Science, written by the Lawrence Hall of Science at UC Berkeley and integrated into a digital platform developed by Amplify. Amplify Science is aligned with the Next Generation Science Standards (NGSS) three dimensions (Disciplinary Core Ideas, Scientific and Engineering Practices, and Cross-cutting Concepts) which are integrated into individual performance expectations which guide both instruction and assessment. The Amplify Science program engages learners in phenomenon-anchored science and engineering unit storylines as its instructional model. At the 7th grade level, students get an integrated course of Physical Science and Engineering Design topics.

Scope and Sequence

Timeframe	Unit	Instructional Topics
3 - 4 weeks (September)	**Unit 1 - Foundations of Science**	• Lab Safety • Lab Equipment • Scientific Method • Graphing and Data Interpretation • Metric Measurement • Scientific Arguments (CER)
2-3 Weeks (October)	**Unit 2 - Amplify Science: Harnessing Human Energy**	• Level 1: What is Energy? • Level 2: The Rescue Team's Energy Needs. • Level 3: Designing an Energy Solution.
3 Weeks (November)	**Unit 3- Electricity**	• Charge & Static Electricity • Current Electricity • Ohm's Law • Circuits • Dream Home Project (STEM)
4 Weeks (December)	**Unit 4- Amplify Science: Phase Change**	• Level 1: Describing Phase Change • Level 2: Investigating Energy and Phase Change. • Level 3: Investigating Attraction and Phase Change.
2 Weeks (January)	**Unit 5- Atom & Periodic Table**	• History of Atom Model • Identify atoms using atomic mass & number. • Create models of atoms using periodic table. • Describe organization of periodic table.
4 Weeks (January/February)	**Unit 6 - Amplify Science: Chemical Reactions**	• Level 1 :Properties & Atoms • Level 2 :Reactions • Level 3: Accounting for Atoms

Last Updated: August 2022

4 Weeks (February)	**Unit 7- Amplify Science: Thermal Energy**	• Level 1: Understanding Temperature • Level 2: Temperature & Energy Level 3: Changes in Temperature
4 Weeks (March)	**Unit 8 - Amplify Science: Forces and Motion**	• Level 1: Force & Velocity • Level 2: Mass & Velocity • Level 3: Collisions
4 weeks (April)	**Unit 9 - Amplify Science: Light Waves**	• Level 1: Changes Caused by Light • Level 2: Light as a Wave • Level 3: Light Interactions
4 weeks (May)	**Unit 10 - Amplify Science: Magnetic Fields**	• Level 1: Modeling Magnetic Force • Level 2: Investigating Potential Energy • Level 3: Strength of Magnetic Force
Optional-	**Force & Motion Engineering Internship Phase Change Engineering Internship**	

UNIT 1: Foundations of Science

Description:

Students are introduced to the study of physical science including classroom and lab safety, physical science equipment and the scientific method. Students will dive more deeply into experimental design, variables and data collection. These concepts will be reinforced throughout the course. Data will be primarily collected using the metric system and basic metric measurements for volume, mass, length, temperature and density will be studied. Throughout the course, students will be asked to frame written arguments with a claim, evidence and reasoning (CER). Students will be introduced to CER in this unit and will continue to practice in each of the course units.

Essential Standards:

- MS-LAB 1: I can demonstrate the ability to create, read, and interpret visual displays such as graphs, charts and tables.
- MS-LAB 2: I can demonstrate appropriate techniques, explain the importance of safety, and follow correct procedures in lab situations.
- MS-LAB 3: I can clearly communicate scientific information using reasoning and appropriate evidence to support a claim in a scientific argument.

Learning Targets:

- Students can identify and follow safety guidelines related to heat/fire safety, eye protection, electrical safety, chemical safety and glassware safety.
- Students can cite supporting evidence and communicate scientific reasoning to draw a conclusion.
- Students can identify and properly use lab equipment including glasswares, heat sources, and other physical science lab equipment.
- Students will employ the skills of observing, inferring, and predicting to learn more about the world.
- Students will employ the scientific method to correctly design, conduct, record data, analyze, and propose conclusions to experiments.
- Students will conduct investigations and effectively communicate the results through mathematical data and carefully designed criteria.
- Students will relate the standard system of measurement (SI) to compare data and communicate results with each other.

UNIT 2: Harnessing Human Energy

Description:

Scientists continue to devise new ways to harness human energy. Energy-harvesting backpacks, bikes, rocking chairs, and knee braces are just a few of the innovative devices that have been created to capture human energy and use it to power electrical devices. In this unit, students assume the role of student energy scientists in order to help a team of rescue workers with an energy problem. Students work to find a way to get energy to the batteries in the rescue workers' electrical devices, even during power outages, and this serves as the design problem for the unit. First, students are motivated to explore relationships between different types of energy—with an emphasis on kinetic energy and potential energy—and the ways energy is transferred and converted. To solve the rescue team's energy problem, students research various ways to capture and store energy. Then, students apply their knowledge about energy to design an energy system that can use human kinetic energy to power an electrical device.

Essential Standards:

- MS-PS3-1. 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.
- MS-PS3-2. 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.
- MS-PS3-5. 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.
- MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Learning Targets

Chapter 1: What Is Energy?

- Students share their initial ideas about energy, use digital models, and build energy systems to identify examples of energy and investigate the difference between kinetic energy and potential energy (energy and matter).
  - Use digital models
  - investigate differences

- Chapter 2: The Rescue Team's Energy Needs
  Students gather evidence from a digital model, articles, and a demonstration to investigate how energy is transferred (energy and matter) within a system of objects.
  - Gather evidence from a digital model
  - Investigate

- Chapter 3: Designing an Energy Solution
  Students obtain and evaluate information from articles about existing devices that capture human energy and apply knowledge of potential and kinetic energy and energy transfer (energy and matter) to design an energy system (systems and system models) for the rescue team. Students then evaluate and analyze evidence to construct arguments about a fictional energy-harnessing product.
  - Gather evidence from articles
  - Design a system
  - Analyze and evaluate evidence to construct an argument.

UNIT 3: Electricity

Description:

Following the Amplify unit “Harnessing Human Energy", students will have learned about different forms of renewable and nonrenewable energy resources. Electricity is one of the most common forms of energy students encounter on a daily basis. In this unit, students will start with a discussion of charge and static electricity. Exploration with a VandeGraaf generator will reinforce the ideas of conduction, induction and friction. Generation of current electricity will be explored and students will use the mathematical formula I=VR and use Ohm’s Law to determine current, voltage and resistance in a circuit. Series and parallel circuits will be compared. Lastly, students will apply what they have learned by designing the electrical needs of their dream home. Students will select a floor plan, place electrical outlets, plan for the home’s electrical needs and group outlets on 20 amp circuits.

Essential Standards:

- MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3: 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.
- 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.
- MS-PS2-3: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

Learning Targets:

- Students will apply the steps of the engineering design process to solve a problem
- Students will conduct investigations and effectively communicate the results through mathematical data and carefully designed criteria.

UNIT 4: Phase Change   4 Weeks

Description:

Our existence on Earth depends on the abundance of water found here. This water can be found in three different phases: solid, liquid, and gas. Until recently, it was thought Earth was the only place in our solar system with liquid lakes and seas. However, NASA’s Cassini-Huygens mission has discovered the presence of lakes and seas on Titan, one of Saturn’s moons. Similar to liquids on Earth, the liquids in these lakes and seas undergo changes in phase. Unlike Earth, however, these bodies do not consist of water. They are made of hydrocarbons such as methane. In a picture taken by a space probe in 2007, a large lake of liquid methane was detected. In a picture of the same area taken in 2009, the lake did not appear to be there. Upon further testing, a solid was detected. The solid was either solid methane or solid ground that was underneath the lake. NASA scientists wondered if the lake evaporated or froze. Taking on the role of student chemists working for the Universal Space Agency (a fictional agency), your students will investigate the mystery of the methane lake on Titan. One team of scientists at the Universal Space Agency claims that the lake evaporated while the other team of scientists claims that the lake froze. The apparent disappearance of the lake serves as the anchor phenomenon for the unit, and the students’ assignment is to determine what happened to the lake. Motivated to understand phase change more deeply, students gather evidence from the *Phase Change* Simulation, from several articles, and from physical investigations of phase change. They learn that the molecules of a substance move differently when that substance is in different phases. They also learn how the kinetic energy of molecules and the attraction between the molecules affects the way in which the molecules move. Students use this newfound understanding of molecules, kinetic energy, and attraction, as well as evidence about the conditions on Titan, to explain what they think happened to Titan’s mysterious lake.

Essential Standards:

- MS-PS1-4. 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.
- MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.
- MS-PS3-4. 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.
- MS-PS3-5. 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.

Learning Targets

- Chapter 1: Describing Phase Change at Two Scales

Students use hands-on experiences and a digital model to investigate phase changes at the macroscale and molecular scale (scale, proportion, and quantity) in order to construct explanations about what happens to molecules in a phase change.
- Investigate phase changes
- Construct explanations

- Chapter 2: Investigating Energy and Phase Change
  Students gather evidence from reading and using a digital model to make arguments about how a transfer of energy (energy and matter) caused changes at the molecular scale (scale, proportion, and quantity), which led to the liquid in a lake on Titan changing phase and turning into gas.
  -Gather evidence from reading to make an argument

- Chapter 3: Investigating Attraction and Phase Change
  Students use a physical model to investigate how molecular attraction affects phase change. They then create their own models to explain how the kinetic energy of a substance (energy and matter) must overcome the molecular attraction of that substance's molecules (scale, proportion, and quantity) in order for a phase change to occur.
  - Use a physical model to investigate
  - Create your own model

- Chapter 4: Science Seminar
  Students analyze evidence and make oral and written arguments, using what they have learned about phase change at the macroscale and molecular scale (scale, proportion, and quantity), to explain the causes of the failure of a liquid oxygen machine (cause and effect).
  - Analyze evidence to make oral and written arguments

UNIT 5: Atom & Periodic Table 2-3 Weeks

Description:

The periodic table is not taught in Amplify Science units but it is helpful for students to have a basic understanding of atoms, elements and the organization of the periodic table prior to studying chemical reactions. Students learn the atomic history and the design of the periodic table of elements over time. Students research one element in depth and share their findings.Patterns on the table are discussed and students can use this information to make predictions about unknown elements.

Essential Standards:

- MS-PS1-1: I can construct models of atoms and simple molecules.
- MS-PS1-2: I can distinguish between physical and chemical properties and changes of matter.
- MS-PS1-3: I can describe how synthetic materials come from natural resources and impact society.

Learning Targets:

- Students will explore patterns found in the Periodic Table and infer locations of elements based on their properties.
- Students will identify elements by the number of protons found in the nucleus of atoms.
- Students will compare abstract models of atoms to our understanding of their composition and properties.
- Students will investigate the chemical/physical properties of metals and nonmetals.
- Students will construct models of atoms and simple molecules using the periodic table.

UNIT 6: Chemical Reactions 4 Weeks

Description:

Chemists answer questions about what substances are and where they come from. In this unit, students take on the role of student chemists to solve mysteries that can only be solved with an understanding of fundamental chemical principles. The first mystery is a fictional yet realistic scenario in which a reddish-brown substance is coming out of the water pipes in a neighborhood that gets its water from a well. This scenario serves as the anchor phenomenon for the unit. As students learn about what makes substances different in Chapter 1, they apply their growing knowledge of properties and atomic composition to determine that the reddish-brown substance is not the same substance as either the substance that makes up the pipes or the fertilizer that has seeped into the well water. As students learn about chemical reactions in Chapter 2, their explanation builds. Students apply what they have learned about atomic rearrangement to determine that the reddish-brown substance, now identified as rust, could only have formed from a chemical reaction between the iron pipes and the fertilizer. As students learn about the conservation of matter in Chapter 3, their explanation culminates with the conclusion that the reaction between the iron pipes and the fertilizer that formed the rust must also have formed another substance, which must be present in the water. In the last chapter of this unit, students continue in their role as student chemists, working to assist in a police investigation of a robbery that involved the use of an unknown substance to steal a rare and expensive diamond. Students must use their understanding of substances, atoms, and chemical reactions to identify the unknown substance as hydrofluoric acid. They then help the police determine which of their suspects is most likely to have produced this substance.

Essential Standards:

- MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.
- MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
- MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
- MS-PS1-5. 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.
- MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

Learning Targets / 3D Statements:

Chapter 1: Properties and Atoms

- Students begin to investigate a mysterious reddish-brown substance discovered coming out of the water pipes in a fictional community. They first observe substances at the macroscale and then use the digital model (a simulation) to observe substances at the atomic scale to figure out that observable differences between different substances are the result of differences at the atomic scale (scale, proportion, and quantity).
  - investigate
  - use a digital model/ simulation

Chapter 2: Reactions

- In order to construct explanations about how the rust in Westfield's water formed, students gather evidence from hands-on activities, a physical model, and the digital simulation to investigate whether or not it is possible for

substances to change into different substances (scale proportion, and quantity; cause and effect). Then students construct visual models of how atoms are rearranged during a chemical reaction (patterns).
- Construct explanations
- Gather evidence
- Physical model
- Visual model

Chapter 3: Accounting for Atoms

- Students investigate how atoms are neither created nor destroyed during a chemical reaction (scale proportion, and quantity; patterns). First they obtain information from an article and the digital model about what happens to fuels as they burn. Next, students construct visual models and write explanations about how the atoms in the pipes and in the fertilizer were rearranged into different patterns to form rust and another product.
  - investigate
  - obtain information from an article
  - construct visual models and write explanations
  - digital model

Chapter 4: Science Seminar

- Students analyze evidence and make oral and written arguments—using what they have figured out about substances at the macroscale and atomic scale and about how atoms rearrange during a chemical reaction (scale, proportion, and quantity; patterns)—to create models that distinguish between suspects who could and could not have made hydrofluoric acid.
  - create models
  - analyze evidence and make oral and written arguments

UNIT 7: Thermal Energy   4 Weeks

Description:

In their role as student thermal scientists, students work with the principal of Riverdale School, a fictional school, in order to help choose a new heater system. The principal is considering two proposed systems, both of which would use water to heat the school. However, these systems differ in important ways. How these two systems work serves as the anchor phenomenon for this unit and the explanations students make allow them to make a recommendation to the principal. The water heater system uses a small amount of warmer water to heat the school. The groundwater system uses a large amount of slightly cooler water to heat the school. Throughout the unit, students are called upon to analyze the differences between these two systems at the molecular scale and to explain how and why they will heat the school. To do so, students make use of the Thermal Energy Simulation, which provides evidence about the molecular nature of temperature and its relationship to kinetic energy. At the end of Chapter 3, students make a recommendation to the principal in favor of the system that will heat the school more during the winter.

Essential Standards:

- MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
- MS-PS3-4. 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.
- MS-PS3-5. 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.

Learning Targets:

Chapter 1: Understanding Temperature

- Students gather evidence from a hands-on experiment and a digital model about temperature at the macroscale and molecular scale (scale, proportion, and quantity). They then construct explanations and visual models to communicate their understanding that an increase in the temperature of a substance is an increase in how fast its molecules are moving (energy and matter)
  - gather evidence from an experiment and digital model
  - construct explanations to communicate
  - construct models to communicate

Chapter 2: Temperature and Energy

- Students gather evidence from digital and physical models and from a science article about the relationship between motion at the molecular scale and kinetic and thermal energy (energy and matter; scale, proportion and quantity) and about how energy transfers between substances until the system becomes stable when the objects are at the same temperature (stability and change). Students apply their understanding to construct explanations and visual models of how two proposed heating systems would warm a school.
  - construct explanations and visual models
  - gather evidence from digital and physical models
  - gather evidence from an article

Chapter 3: Changes in Temperature

- Students use mathematical thinking as they figure out how changes in temperature are affected by differences in both the kinetic energy and number of molecules that make up the things in a system (scale, proportion, and quantity). They construct explanations and visual models showing which of two heating systems would warm a school more.
  - use mathematical thinking
  - construct explanations and visual models

Chapter 4: Water Pasteurization

- Students apply what they have learned about temperature, kinetic energy, energy transfer, and equilibrium (energy and matter, stability and change) to analyze evidence and engage in oral argumentation about whether or not pasteurization kits distributed on a fictional island after a hurricane will heat water above 65℃ if directions are followed.
  - analyze evidence
  - engage in oral arguments

UNIT 8: Forces & Motion   4 Weeks

Description:

Scientists send research instruments into space to collect data on astrophysical objects such as stars, planets, moons, and asteroids. These missions are incredibly expensive and require precise and meticulous planning to avoid failure. The teams of scientists and engineers who work together to design and build the spacecraft usually plan successful missions, but occasionally, costly mishaps occur. When these happen, scientists carefully investigate what went wrong, wanting to avoid future mistakes. In this unit, students engage in authentic work as they take on the role of student physicists working for the fictional Universal Space Agency (USA). They are called upon to assist in the investigation of one recent mishap. Students apply their developing knowledge of force and motion to explain why a space pod failed to dock at the space station as planned. This mystery serves as the anchor phenomenon for the unit. As they investigate, students will learn about the relationship between force, change in velocity, mass, and the equal and opposite forces exerted during collisions. This complex physics reasoning will be reinforced by the Force and Motion Simulation, a digital environment in which students can manipulate the mass of objects, their initial velocities, and the forces exerted on them as they observe the resulting change in motion. Students can also use this digital tool to simulate collisions and see how different objects are affected during these events. With this digital tool, students gather data about how forces affect the motion of objects, which they use as evidence to explain what happened to the pod. By the end of the unit, students will understand how forces can affect the motion of objects.

Essential Standards:

- MS-PS2-1. Apply Newton's third law to design a solution to a problem involving the motion of two colliding objects.
- MS-PS2-2. 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.
- MS-PS3-1. 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.

Learning Targets:

Chapter 1: Force and Velocity

- Students conduct investigations with hands-on materials and analyze data from a digital model to discover ways that a force can affect an object's velocity (cause and effect) and that an object's motion remains stable unless it is changed by a force (stability and change).
  - analyze data from a model
  - conduct investigations

Chapter 2: Mass and Velocity

- Students investigate the relationship between force, mass, and velocity (cause and effect) by planning and conducting physical experiments, conducting tests with a digital model, and using mathematical thinking to make sense of their results. They also obtain information by reading an article about designing wheelchairs for different purposes.
  - planning and conducting experiments
  - conduct tests with a digital model/ simulation
  - use mathematical thinking
  - obtain information from an article

Chapter 3: Collisions

- Students obtain evidence from an article and analyze data produced in experiments and in tests with a digital model. They discover that equal and opposite forces act on the objects in a collision, but these forces affect the objects differently when the objects have different masses (cause and effect).
  - obtain evidence from an article
  - analyze data from a digital model

Chapter 4: Force, Motion, and Movie Sets

- Students analyze evidence and construct oral and written arguments—using what they have learned about force, velocity, mass, and collisions—to explain what caused two collisions in movie scenes to have different outcomes (cause and effect).
  - analyze evidence and construct oral and written arguments

UNIT 9: Light Waves 4 Weeks

Description;

The Light Waves unit helps students gain a deeper understanding of how light interacts with materials and how these interactions affect our world, from the colors we see to changes caused by light from the sun, such as warmth, growth, and damage.

In this unit, students investigate a specific change caused by light: skin cancer. Australia has one of the highest skin cancer rates in the world: More than half of the people who live there will be diagnosed with skin cancer in their lifetime. Scientists have investigated the factors that place Australia's population at such an exceptionally high risk of skin cancer. They have found that less ultraviolet light is absorbed as it passes through the atmosphere above this region due to ozone depletion. They have also found that the Australian population is more susceptible to skin cancer because of the large proportion of people with light skin tones. This is because people with lighter skin tones have less melanin in their skin cells than people with darker skin tones. Melanin absorbs ultraviolet light before it damages genetic material inside skin cells, providing some protection against damage caused by light from the sun. Therefore, people with low levels of melanin in their skin cells are at a greater risk of developing skin cancer than people with higher levels of melanin in their skin cells.

Taking on the role of student spectroscopists working for the fictional Australian Health Alliance, students investigate why Australia's cancer rate is so high, analyzing real data that scientists might consider. This problem serves as the anchor phenomenon that students focus on throughout the unit. Students use the Light Waves Simulation, conduct hands-on activities, read articles, and watch videos to gather evidence about how light interacts with materials. The Sim allows students to observe how light carries energy and how this energy causes materials to change when it is absorbed. Students can simulate manipulating the wavelength of light, observing that different types of light have different wavelengths and that different types of light can change a material in different ways. Students also learn that when energy from light is not absorbed by a material, it can be either reflected or transmitted. Students apply these ideas to construct an argument explaining the high skin cancer rate in Australia, citing both low ozone levels in the atmosphere and low levels of melanin in the population.

Essential Standards:

- MS-PS4-1. 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.
- MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
- MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. [

Learning Targets:

Chapter 1: Changes Caused by Light

- Students gather evidence from a digital model, articles, and hands-on investigations about how energy from light can cause matter to change (energy and matter), including how energy from sunlight can cause changes to genetic material, which can lead to skin cancer (cause and effect).
  - gather evidence from models, articles, and investigations

Chapter 2: Light as a Wave

- Students analyze evidence from a digital model, articles, and hands-on investigations to determine that different types of light have different wavelengths and can cause different changes when interacting with matter (energy and matter, cause and effect) and that the amount of melanin in skin can influence the risk of skin cancer.
  - analyze evidence from models, articles, and investigations

Chapter 3: More Light Interactions

- Students use a digital model and hands-on materials to investigate how energy from light can be absorbed, transmitted, or reflected by different materials (energy and matter). They use this knowledge to analyze and interpret evidence and construct explanations about the cause of Australia's high rate of skin cancer.
  - use a digital model
  - analyze and interpret evidence
  - construct explanations based on the evidence

Chapter 4: Science Seminar

- Students analyze evidence and construct oral and written arguments—using what they have learned about energy from light of different wavelengths and its interactions with different types of matter (energy and matter)—to determine whether enough light is transmitted through ocean water for crabs to see the plankton they eat near the ocean floor and, if so, what color the plankton appear.
  - analyze evidence and construct oral and written arguments

UNIT 10: Magnetic Fields
4 Weeks

Description:

Space exploration generates excitement and captures imaginations, while also leading to major breakthroughs in science and technology. However, the rockets used to launch spacecraft are very expensive, and most can only be used one time. To prepare for future large-scale space projects, such as space colonization, scientists must find a cheaper and faster launch system. NASA scientists believe that a promising technology already exists in the form of electromagnetic launch systems, but the technology needs further development. In the role of physicists working for the Universal Space Agency, a fictional agency that resembles NASA, students investigate the unexpected results from one test launch of a magnetic spacecraft. While scientists at the USA were testing the launch system, they found that the spacecraft in their third test traveled much faster than expected, and it's this unexpected outcome that serves as the anchor phenomenon for student investigations in the unit. Was there an error in magnet alignment? Was there an unexpected energy increase in the launcher system, or was there more magnetic force? Motivated to understand what affects the movement of magnets, students use the Magnetic Fields Simulation, hands-on activities, and evidence from science articles to learn about magnetic force. Students gain an understanding of how magnetic force causes motion and the relationship of magnetic force to kinetic and potential energy. Students use this newfound understanding, as well as evidence about the spacecraft test launches, to explain what they think happened in the third test. They then apply their knowledge to analyzing three designs for a magnetic roller coaster launcher.

Essential Standards:

- MS-PS2-3: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
- MS-PS2-4: Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
- MS-PS2-5: 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.
- MS-PS3-2: 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.

Learning Targets:

Chapter 1: Modeling Magnetic Force

- Students obtain and evaluate information from an article about Earth's geomagnetism, and they conduct investigations with magnets and with a digital model. They make discoveries about how magnetic force can cause objects to move (cause and effect) and how magnetic field lines model patterns of magnetic force in a system of objects (patterns, systems and system models).
  - obtain and evaluate information from an article
  - conduct investigations
  - use a digital model/ simulation

Chapter 2: Investigating Potential Energy

- Students obtain information from articles and conduct investigations with physical objects and with a digital model in order to figure out that potential energy can be stored in a magnetic field and then converted into kinetic energy (energy and matter) . Students construct explanations about the system of magnets in the model spacecraft and launcher (systems and system models).
  - obtain information from articles
  - conduct investigations with objects and digital models
  - construct explanations

Chapter 3: Exploring the Strength of Magnetic Force

- Students plan and conduct investigations to determine how the strength of a magnetic force affects the amount of energy that can be stored in the magnetic field that exists among a system of objects (energy and matter, systems and system models). They then analyze evidence and evaluate claims about the model spacecraft

launches in order to construct written scientific explanations about the unexpected test results.
- plan and conduct investigations
- analyze evidence and evaluate claims
- construct written explanations

Chapter 4: Designing Roller Coasters

- Students analyze evidence, test variables in a digital model, and use their knowledge of magnetic force, potential and kinetic energy, and systems of magnets (energy and matter, systems and system models) to construct oral and written arguments about which of three electromagnetic roller coaster designs will launch a car the fastest.
  - analyze evidence
  - test evident in a digital model
  - construct oral and written arguments