North Hampton School

8th Grade Science Class Framework

Class Description: While developing essential study and note taking skills in preparation for High School, students start the year with physics. We start by creating an understanding of Newton's Laws while figuring out why some things break and others don't. After several investigations of those forces and what materials are able to disperse forces, students design an egg protection device to drop off of the gymnasium roof. Students then move onto sound waves and non-contact forces found in magnets. Sound from a loud truck speaker can cause a window to shake and they figure out it is through the vibrations of particles and how the changes in those vibrations can cause sound to have different pitch and amplitude. Further investigation of how a speaker works is where they develop their understanding of magnetic forces. We then expand their horizons to Earth's place in space to develop different perspectives of how the solar system affects humans and how Earth fits into the Galaxy, and how that fits into the greater Universe. Lastly, we make a shift to the finite details of how life can be different from species to species as well as how organisms evolve into different species.

Habits of Learning:
Self-Direction: Students will initiate and manage personal learning, and demonstrate a "growth" mindset, through self-awareness, goal-setting, ownership, perseverance, managing learning, and self-reflection in order to develop personal goals.

Course Outline of Essential Content

Unit of study: Force and Motion

Essential question: Why do things sometimes get damaged when they hit each other?

Key concepts/content to be covered in unit:
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.
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.

Skills to be addressed:
I can plan and carry out investigations and analyze and interpret data to figure out that all solid objects behave elastically up to a point and that the forces between objects in a collision are always equal in size and opposite in direction.
I can develop and use free body diagram models to represent the changes in the relative strength of forces on different objects in a collision.
I can create and use mathematical models to determine how changes in the mass and speed of an object affect the amount of kinetic energy that object has.
I can develop and use system models to support explanations for how contact forces, including friction and air resistance, cause energy to be transferred from one part of the system to another before, during, and after a collision.
I can plan and carry out investigations to determine which cushioning materials reduce peak forces the most in a collision.
I can develop macroscopic models of small and microscopic structures of these materials and use these to generate data about how space to deform, contact time in a collision, and peak forces in a collision are related.
I can carry out investigations and analyze data about how the shape and size of cushioning materials affect force distribution in a cushioning structure.
I can optimize designs solutions using evidence from these investigations to solve different design problems.

Unit of study: Non-Contact Forces Part 1 (Sound Waves)

Essential question: How does a sound make something move?

Key concepts/content:
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.

Skills to be addressed:
I can develop a model of vibration that captures important ideas about how changes in the frequency and amplitude of the vibrations can explain these different characteristics of sounds.
I can use models to show how sound travels from one location to another by causing sequences of vibrations through matter.
I can use data to develop models to show how sounds can be absorbed and transmitted.

Unit of study: Non-Contact Forces Part 2 (Magnets)

Essential question for unit: How can a magnet move another object without touching it?

Key concepts/content:
MS-PS2-3: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
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.
MS-PS4-3: 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.

Skills to be addressed:
I can develop and refine a model about forces (pushes and pulls) that includes magnetic forces interacting at a distance via fields that extend through space.
I can revise a model for explaining magnetic forces to include electromagnets that act as permanent magnets in many ways but can be manipulated by changing the electric current.
I can consider the transfer of energy in their model, and the connections between forces, energy and magnetic fields.
I can plan and carry out a series of investigations to test how changes in one part of a magnetic system (e.g., number of coils, diameter of coils, strength of magnet) affect the magnetic forces in the system.
I can construct an explanation based on evidence to explain that magnetic fields extend through space and predict the strength and direction of magnetic forces.

Unit of study: Earth in Space

Essential questions: How are we connected to the patterns we see in the sky and space?

Key concepts/content:
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-ESS1-1: Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
MS-ESS1-2: Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
MS-ESS1-3: Analyze and interpret data to determine scale properties of objects in the solar system.

Skills to be addressed:
I can develop and use both physical and conceptual models of objects in space to explain seasonal temperature variation across the globe, lunar phases, lunar eclipses, solar eclipses, and transits of Venus and Mercury.
I can attend explicitly to the perspective taken by the observer in their systems models and eventually include multiple perspectives at various scales, beginning here on Earth and expanding out to include the solar system and galactic scales.
I can use simulations to look for patterns of objects over time, including carrying out experiments on how the part of the Moon that is visible at a particular part of a lunar month is related to the position of the Moon related to the Earth and a person on Earth and the factors that influence the orbits of one object around another.
I can analyze, interpret, and collect data about objects in the solar system in order to gather evidence to explain the patterns we see in the sky and space with both our unaided eyes and from telescopes and spacecraft, as well as results from a computer simulation of the formation of the solar system.

Unit of study: Heredity

Essential question: Why are living things different from one another?

Key concepts/content:
MS-LS1-2: Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
MS-LS1-4: Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
MS-LS3-1: Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
MS-LS3-2: Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
MS-LS4-5: Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Skills to be addressed:
I can obtain, evaluate, and communicate information about muscle substructure, the influence of exercise on muscle development, the function of the myostatin protein, selective breeding, examples of asexual reproduction, and how different traits are influenced by environmental and

genetic factors.
I can use mathematics and computational thinking to find the probability of offspring with certain genotypes from parents with certain genotypes.
I can develop and use a model to explain how genes provide instructions to rearrange building blocks from food into proteins, which then influence phenotypes.
I can construct an explanation for how specialized plant structures support sexual and asexual reproduction in plants.
I can develop and use a model to explain that environmental and genetics factors both influence trait variations in different amounts depending on the specific situation.

Unit of study: Natural Selection and Common Ancestry

Essential question: How could things today be connected to the things that lived long ago?

Key concepts/content:
MS-LS1-4: Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
MS-LS4-1: Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
MS-LS4-2: Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
MS-LS4-3: Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.
MS-LS4-4: Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
MS-LS4-6: Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

Skills to be addressed:
I can analyze and interpret data to reveal patterns of connection among modern organisms and between modern and fossil organisms based on anatomical similarities and differences.
I can analyze and interpret data regarding the changes that have occurred in different types of organisms and in the environment throughout the history of life on Earth.
I can ask questions about the mechanisms that cause changes in the heritable traits in a population of organisms over time.
I can obtain, evaluate, and communicate information about structures and how their functions

support survival and successful reproduction in new environments.
I can develop and use a model of cause-and-effect mechanisms (natural selection) that lead to the predominance of certain trait variations in a population and to the suppression or elimination of others.
I can use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic behaviors and specialized structures affect the probability of successful reproduction of different species of penguins in different environments.
I can construct an explanation for lines of evolutionary descent using evidence for what traits remain relatively stable and which are changing and explain how natural selection could cause these changes.
I can argue using data from the physical structures apparent in different types of animals (species) at different stages of embryological development that emphasize new ideas about how different types of living things (species) may be connected.

Texts and Media Used:

Open Sci Ed
Findings from the Field