NGSS Physical Science

2019-2020 Yearlong Course

**Course outlines are updated every school year. Please request the current year's outline from your HST.*

Suggested breakdown:

- Semester 1 - Units 1, 2, and 3
- Semester 2 - Units 4 and 5

Course Overview:

This physical science course addresses overarching ideas of two branches of science, chemistry and physics, in accordance with the Next Generation Science Standards (NGSS), which emphasize critical thinking and engineering practices. Students will develop strong communication skills to communicate their questions, hypotheses, methods, and findings. Students will incorporate graphs and tables to represent their quantitative and qualitative data and use this evidence to support their claims. Upon completing the class, students will have foundational scientific knowledge of the laws and theories regarding matter and energy that encourages the application of science to real-life contexts.

Unit 1: Introduction to Matter: Atoms, Elements, and the Periodic Table

Unit 1 Skills/Assignments:

Assignments:

- Option 1: Element Project - In this assignment, students will research an element of their choice from the periodic table. Using reference materials and Internet sites, they will collect information about the element. They will then present their findings in a multimedia presentation using scientific language, which should include information such as: periodic table information, physical and chemical properties of the element, information on the discovery of the element, information about the location of the element and how it is obtained, and uses of the element.
- Option 2: Students will present an educationally equivalent option to the teacher for approval.

Student will complete one of the below: (Lab Write-up with Sentence Frames; Lab Write-up)

- Density of Solids Lab - Students will calculate the density of several solid objects. They will learn to use a variety of tools to measure the mass and volume of various solid objects. They will then use density to identify an unknown substance. Students will determine that two objects are roughly the same volume but have significantly different densities. They will identify independent variables, dependent variables, and controls

after writing their own questions, creating their own experimental groups and testing their own hypotheses.
- Option 2: Students will present an educationally equivalent option to the teacher for approval.

Skills to be demonstrated within this unit:

- Students will understand scientific methods; including an introduction to different ways of setting up an experiment using the necessary variables, determining bias, using various tools for measurement, converting units, and analyzing data using graphs.
- Students will learn to use basic tools to measure data, such as tape and metric ruler, calculator, balance, graduated cylinder, beaker and thermometer.
- Students will learn to differentiate between atoms, elements, molecules, and compounds, and use patterns in the periodic table to identify and explain atomic number, atomic mass and predict properties of metals, nonmetals, and metalloids.
- Students will understand the physical and chemical properties of the three states of matter, and differentiate between physical and chemical properties.
- Students will learn to calculate mass, volume, and density.

Unit 2: Bonding, Chemical Reactions, Solutions and Mixtures

Unit 2 Skills/Assignments:
Assignments:

- Option 1: Balancing Chemical Equations Assignment- Students will demonstrate how to balance chemical equations and explain what it means for a chemical equation to be balanced. They will be provided with a series of unbalanced chemical equations, which they will have to complete and balance. Initially, students will be provided the entire equation to balance, but will build up to completing a page of equations wherein they determine what the products of the reaction. They will produce balanced chemical equations to the law of conservation of mass, explain how mass is conserved in chemical equations, and identify the parts of a chemical equation.
- Option 2: Students will present an educationally equivalent option to the teacher for approval.

Student will complete one of the below: (Lab Write-up with Sentence Frames; Lab Write-up)

- Option 1: Acids and Bases Lab **(see Inspire Lab Kit)** - Students will determine the pH of various solutions using an indicator. In Part I of this experiment, students will examine a demonstration of how the pH scale works by creating pH scales with solutions of varying

concentrations of H+ and OH– ions. In Part II, students will test the pH of various substances and examine how concentration affects pH in order to rank the solutions from acidic to basic. They will explain the relationship between pH and the properties of a substance, which they will support with reasoning and evidence from their experimental data.

- Option 2: Students will present an educationally equivalent option to the teacher for approval.

Skills to be demonstrated within this unit:

- Students will learn to determine the number of atoms of each element in a chemical formula, use formulas to represent compounds, complete electron dot diagrams, explain why atoms bond, and identify the three types of bonds.
- Students will learn how to describe evidence that a chemical reaction has occurred, balance chemical reactions, distinguish among the types of chemical reactions as they learn to predict the product of each type of reaction.
- Students will understand how to compare the properties of acids and bases, classify them based on strength, and explain what happens during a neutralization reaction.

Unit 3: Motion, Forces, Work and Energy

Unit 3 Skills/Assignments:

Assignments:

- Option 1: Momentum Assignment - Students apply Newton's third law of motion to understand what happens to momentum when two objects collide. They will define and calculate momentum. Students will explain how momentum is conserved using scientific reasoning for an audience of peers.
- Option 2: Students will present an educationally equivalent option to the teacher for approval.

Student will complete one of the below: (Lab Write-up with Sentence Frames; Lab Write-up)

- Option 1: Motion Lab - Students will measure changes in motion of a moving objects, interpret data to determine acceleration, and measure distance and time to determine speed. They will create and interpret graphs to investigation the relationships between speed, velocity, and acceleration. Students will learn to use, predict, and interpret calculations using the following formulae:

  Speed = distance / time

Velocity = displacement / time
Acceleration = change in speed / time
Students will compare graphs that show speed as a function of time to determine whether the acceleration is constant or changing.

- Option 2: Students will present an educationally equivalent option to the teacher for approval.

Skills to be demonstrated within this unit:

- Students will understand movement, forces, energy, work, and machines.
- Students will be able to describe how energy is stored, moves, and changes form. They will use a reference point to calculate distance and time, and evaluate the speed and velocity of an object.
- Students will learn how to solve problems involving momentum, acceleration, net force, gravity, friction, unbalanced forces, and balanced forces in a given diagram.
- Students will understand how to calculate examples of potential and kinetic energy, as well as work and power while they calculate work, power, and the mechanical advantage of simple machines.
- Students will be able to explain Newton's three laws of motion, recognize examples of each, and calculate the force of an object using Newton's second law (F=ma).

Unit 4: Temperature and Heat

Unit 4 Skills/Assignments:

Assignments:

- Option 1: Thermal Energy Assignment - Students will observe, calculate, and compare the specific heat of water with the specific heat of other substances to determine the amount of thermal energy that an object can transfer. By producing a number of calculated specific heats and answering questions about how energy flows, students will predict how thermal energy flows between objects at different temperatures. Furthermore, they will distinguish between heat and thermal energy, and explain why some substances change temperature more easily than others.
- Option 2: Students will present an educationally equivalent option to the teacher for approval.

Student will complete one of the below: (Lab Write-up with Sentence Frames; Lab Write-up)

- Option 1: Thermal Energy Transfer Lab **(see Inspire Lab Kit)** - In this lab students will determine how mass affects the amount of thermal energy transferred as they develop and conduct an investigation of how different materials transfer thermal energy. They will observe and compare the specific heat of water with the specific heat of other substances. Students must use mathematical computations to calculate specific heat, or the amount of thermal energy that an object can transfer using the fact that that water has a relatively high specific heat (4.18 J/g°C), whereas metals, have a relatively low specific heat [for example: the specific heat of steel (0.49 J/g°C) is approximately half that of aluminum (0.90 J/g°C), while that of lead is approximately a third that of steel (0.16 J/g°C)].
- Option 2: Students will present an educationally equivalent option to the teacher for approval.

Skills to be demonstrated within this unit:

- Students will understand temperature in terms of average kinetic energy of atoms and molecules, and contrast it with heat, a method of energy transfer in matter.
- Students will learn not to think of thermal energy in terms of "hot" or "cold," but to recognize that thermal energy is a type of molecular kinetic energy and that when thermal energy increases, molecular motion increases.
- Students will learn to convert temperature readings between Fahrenheit, Celsius, and Kelvin scales.
- Students will understand real world examples of how energy is transferred by conduction, convection, and radiation.
- Students will understand the concept of specific heat, and be able to explain the Laws of Thermodynamics as heating and cooling systems.

Unit 5: Sound, Light, Electricity and Magnetism

Unit 5 Skills/Assignments:

Assignments:

- Option 1: Magnets and Magnetism Lab **(see Inspire Lab Kit)** - Students will describe Earth's magnetic field and describe the properties of magnets. They will learn about magnets and magnetism at different scales, and how magnetic poles interact with each other. Students will produce models that illustrate the magnetic field around a magnet.

- Option 2: Students will present an educationally equivalent option to the teacher for approval.

Student will complete one of the below: (Lab Write-up with Sentence Frames; Lab Write-up)

- Option 1: Waves Assignment - The purpose of this activity to experience different types of waves and observe their amplitude, frequency, wavelength and velocity through a slinky or similar object. In this lab, students will model and differentiate between transverse and longitudinal waves according to the direction of their movements as they experiment with the relationship between energy input, amplitude, and interference. Students will produce a written and illustrated report to clarify proper terminology used to describe the structure of waves and demonstrate how their properties are measured.
- Option 2: Students will present an educationally equivalent option to the teacher for approval.

Skills to be demonstrated within this unit:

- Students will learn about how the structure of the waves, such as amplitude, wavelength, period and frequency, determines their characteristics while examining sound waves and light waves.
- Students will be able to explain how charges flow through conductors and insulators. Students will examine Ohm's Law, electrical circuits, and electric current.
- Students will learn about Earth's magnetic field in relation to electromagnetism and its applications.
- After this unit, students will be able to contrast current and alternating current and explain how a generator works.

For step by step lab instructions, please click here.

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