Physical Science

UNIT 1: Motion

ESSENTIAL QUESTION	BIG IDEAS
How can we predict an object's continued motion, changes in motion or stability?	Students are able to describe the various motion of objects Students can graphically represent the motion of an object Students can mathematically determine the motion of an object.

GUIDING QUESTIONS

- **Content**
  - What effects can an acceleration have on an object's velocity?
  - What happens to the velocity of an object as it falls?
  - How does the direction of an acceleration relate to the change in an object's speed
- **Process**
  - How can the velocity of an object be determined from a position time graph?
  - How can the displacement of an object be determined from a velocity time graph?
  - How can the quantities of displacement, initial and final velocity, acceleration, and time be related mathematically?
- **Reflective**
  - In the absence of air resistance, if you dropped two objects then why do they both reach the ground at the same time?
  - What situations on Earth are best described by the assumptions of free-fall motion?

FOCUS STANDARDS

- **HS-PS2-1.** Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration
- **HS-PS2-3.** Apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

Physical Science

UNIT 2: Forces

ESSENTIAL QUESTION	BIG IDEAS
How can we predict an object's continued motion, changes in motion, or stability?	• Apply Newton's Laws of Motion in different physical phenomena • Identify different types of forces acting upon an object • Determine the Net Force acting on an object • Describe Free Fall • Identify the difference between weight and mass

GUIDING QUESTIONS

- **Content**
  - What are Newton's three laws of motion?
  - What is the relationship between an object's mass, the force acting on it, and its acceleration?
  - How can the motion of an object that is not experiencing a net force be described?
  - How are the mass and the weight of an object different?
- **Process**
  - How can the forces acting on an object be represented graphically?
  - How can the acceleration of an object with multiple forces acting on them be calculated?
- **Reflective**
  - Why does it feel like I am pushed into the back of my seat when I first hit the gas when the light turns green?
  - Why does the mass of an astronaut remain the same when they go to a different planet, but their weight changes?
  - When a truck and a car collide, which one experiences the larger force?

FOCUS STANDARDS

- HS-PS2-1 Analyze data to support the claim that Newton's Second Law of Motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration

Physical Science

UNIT 3: Energy

ESSENTIAL QUESTION	BIG IDEAS
How does energy transfer explain change?	• Students understand the conservation of energy, and can describe it using mathematical models • Students will be able to describe the processes of energy transfer, and track where energy flows to and from

GUIDING QUESTIONS

- **Content**
  - What is energy, and what is its SI unit?
  - What does it mean for energy to be conserved?
  - What are the different forms of energy?
  - When is mechanical energy not conserved?
  - What does it mean for an object to “do work”?
- **Process**
  - How can the kinetic and potential energy of an object be calculated?
  - How can the conversation of energy be modeled mathematically?
  - How can the energy lost from a system be calculated?
- **Reflective**
  - Why doesn’t a cup of coffee get hotter when it sits out?
  - Why is the highest hill on a roller coaster always the first one?
  - Why don’t bouncy balls bounce up to the exact same height as they were dropped from

FOCUS STANDARDS

- **HS-PS3-1.** Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
- **HS-PS3-2.** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative position of particles (objects).
- **HS-PS3-3.** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*

Physical Science

UNIT 4: ATOMS AND THE PERIODIC TABLE

ESSENTIAL QUESTION	BIG IDEAS
Why is the periodic table shaped that way?	• Students understand that all matter is made of atoms of the elements on the periodic table. • Students understand the periodic table is an organized representation of elements that can be used to predict atomic structure and properties.

GUIDING QUESTIONS

Content:

- How are the elements of the periodic table classified into categories?
- How does the structure of an atom affect its mass and charge?
- How is energy related to the arrangement of electrons in an atom?

Process:

- What patterns do we see on the periodic table when putting elements in increasing atomic number?
- Why is the quantum mechanical model better at predicting where an electron lives than the shell model?

Reflective:

- If you were Mendeleev, how would you organize the elements?
- Think about each family of the periodic table, do you agree with the name? Why or why not?

FOCUS STANDARDS

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Physical Science

UNIT 5: FORMULAS AND BONDING

ESSENTIAL QUESTION	BIG IDEAS
How do atoms interact with each other?	Students understand how atoms bond, and how the type of bonds give substances their chemical and physical properties.

GUIDING QUESTIONS

Content:

- How does the type of bonding in a substance affect its chemical and physical properties?
- What are the rules for writing formulas and naming compounds containing ionic and covalent bonds?
- How can an atom satisfy the octet rule?

Process:

- How do ionic and covalent bonds determine the properties of a compound?
- What patterns do we see in naming compounds?
- What patterns in bonding determine the structure of a compound?

Reflective:

- How do manufacturers choose the material they use for new products?
- How would our world be different if electrons were positively charged?
- Which is more important: ionic or covalent bonds?

FOCUS STANDARDS

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

Physical Science

UNIT 6: Chemical Reactions

ESSENTIAL QUESTION	BIG IDEAS
How are chemical reactions involved in what we do and see?	Students understand atoms can be rearranged to produce new substances while conserving energy and matter.

GUIDING QUESTIONS

Content:

- How can a chemical change be represented by a balanced chemical equation?
- How can the products of a chemical reaction be predicted based on the type of reaction?

Process:

- How does a balanced equation represent the conservation of matter?
- How can the pattern of reaction types predict the products of a chemical reaction?

FOCUS STANDARDS

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Physical Science

UNIT 7: Chemical Quantities

ESSENTIAL QUESTION	BIG IDEAS
How are quantities of reactants and products in a chemical reaction mathematically related?	Students understand quantitative relationships exist in chemical reactions. How do substances combine or change (react) to make new substances? How does one characterize and explain these reactions and make predictions about them?

GUIDING QUESTIONS

Content:

- How do scientists count and measure atoms?
- How are the amounts of substances consumed and produced in a chemical reaction calculated?

Process:

- Why do stoichiometric calculations always begin with a balanced chemical equation?
- How can dimensional analysis and the mole ratio mathematically determine the amounts of reactant and products involved in a chemical reaction?

Reflective:

- Why do chemists use the unit “mole”?
- How would a business use the concept of stoichiometric relationships when creating a product?

FOCUS STANDARDS

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.