












### 3. CHEMICAL AND PHYSICAL CHANGES













**CORE CONTENT:** Topics should include, but not be limited to:

- physical changes, chemical changes
- boiling point, melting point, solubility
- chemical reactions – exothermic, endothermic
- variables affecting pressure
- atmospheric pressure, cohesion, adhesion
- kinetic molecular theory
- qualitative description of gases: gas laws




















#### ASSESSMENT STRATEGIES:

-  Explain how the faces on Mt. Rushmore are a product of physical change. 
-  Dissolve salt in water. Explain what type of change occurs. Can the salt and water be separated? If yes, how and if not, why not?
-  Make a video or posters in which physical and chemical changes are demonstrated or illustrated. Draw the pictures or gather them from magazines. Clearly label all examples.  
-  Explain why M&M chocolate candies melt in your mouth and not in your hand. 
-  Using ice cubes, explain changes in mass and volume when the state of matter changes.
-  Explain what happens to atoms and molecules when a chemical reaction occurs.
-  Describe different kinds of chemical reactions and how some chemical changes can be prevented.











## ASSESSMENT STRATEGIES (cont'd)

-  Identify several everyday chemical reactions and explain how substances are changed into one or more new substances.
-  Describe and explain four kinds of evidence for chemical reactions.
-  Explain how room freshener, cooking smells, or perfume spray spreads out to fill a room.
-  Define the relationship between volume and pressure of gas.  $\Delta$
-  Explain how hot air balloonists can calculate the amount of air necessary for a lift.  $\Delta$
-  Explain the changes in tire pressure when riding a bike or driving a car on a hot day.  $\Delta$
-  Using a labeled diagram, explain the difference in air pressure at sea level and on a mountaintop.  $\Delta$
-  Make a bottle barometer and observe changes in atmospheric pressure over a seven-day period. Keep a daily log of observations.   $\Delta$
-  Explain why astronauts wear special pressurized suits in space.
-  Write a paragraph explaining the changes that occur in each of the ingredients for chocolate chip cookies when they are mixed and when they are baked. 

## INSTRUCTIONAL STRATEGIES:

-  Explain through the use of demonstrations and examples, how the identifying properties of a substance remain unchanged in a physical change. (Melt ice cubes, tear paper, carve shapes using a bar of soap.)
-  Using a laser disk or with demonstrations, explain melting point and boiling point (the two fixed temperatures at which every substance changes state). Explain the role of heat when matter changes from one state to another. 
-  Explain how the boiling point of a liquid is affected by pressure.
-  List a variety of physical changes. Discuss whether or not it is possible to bring the matter back to the form it was before the physical changes occurred.
-  Invite a photographer to explain how pictures are developed: the chemical processes involved, chemicals used, and the chemical changes that occur.   
-  Prepare cake batter and bake in an oven at school. Discuss how this process includes both physical and chemical changes. 
-  Gather pictures of chemical changes, e.g., *weathering of the Statue of Liberty, a fireworks show, rusty metal, a burned house*. Discuss why these are chemical changes.   
-  Discuss whether or not it is possible for matter to return to the form it was in before the chemical change occurred.
-  Explain why melting ice cubes is a good example of an endothermic reaction and why freezing water is a good example of an exothermic reaction. Discuss other examples.
-  Set up two glasses of clear liquid: one containing water and the other salt water. Do not tell students that the liquids are different. (Morton's kosher salt will dissolve and be clear in solution.) Place a golf ball in each glass. Discuss observations and possible explanations for them. Could students prove their explanations? How does this experiment relate to the fact that ships ride higher in ocean water than in fresh water? 

## INSTRUCTIONAL STRATEGIES (cont'd)






-  Demonstrate and explain examples of the four classic signs that tell whether a chemical reaction has occurred.
-  Demonstrate color change by showing students a dry steel wool pad (S.O.S., Brillo) and one that was soaked in water and allowed to sit for a day or two. Describe the differences and discuss the kind of change that occurred.
-  Demonstrate the release of gas by mixing vinegar and baking soda together. Place the baking soda into a 9" balloon. Place 50 milliliters of vinegar into a 500-milliliter bottle. Place the balloon on the bottle and let the baking soda drop into the vinegar. Observe what happens and discuss why.
-  Invite a chemist to speak to the students about her/his job and what it involves. ☺ 📖
-  Explain exothermic and endothermic reactions using examples of each. Explain the meaning of “exo-” and “endo-”.
-  Explain why the Kinetic Theory is one of the most important theories in modern science. Use a laser disk to show kinetic energy in the molecules of all forms of matter. 📺 🌀
-  Explain how the Gas Laws are physical laws that describe the behavior of a gas when pressure, volume, or temperature is changed.
-  Using examples, show how liquids and gases exert their pressure in all directions and how pressure from liquids increases with depth. Using lab materials, have students investigate the measurement of water pressure. ▽
-  Discuss any changes in atmospheric pressure students may have experienced when riding in an elevator of a skyscraper, flying in an airplane, or ascending a mountain. Explain why the discomfort was felt. ☺
-  Demonstrate the “egg in the bottle” experiment. Have students observe and offer explanations as to how an egg can go magically into a bottle that has a mouth smaller than the egg. Provide materials for students to perform the experiment.

## 4. MATH ASPECTS OF SCIENCE




**CORE CONTENT:** Topics should include, but not be limited to:

- quantities
- mathematical relationships using tables, charts and graphs
- measurements
- introduction to balancing equations
- scientific notation
- metric system




### ASSESSMENT STRATEGIES:

-  Design charts that illustrate frequency distribution.
-  Design an experiment using different types of graphs to illustrate the data.
-  Write a balanced equation from the results of a laboratory assignment.
-  Express the distance the sun is from earth using scientific notation and metric units.
-  Observe numbers you have seen on main highway sign that incorporate decimals, percentages and fractions.

### INSTRUCTIONAL STRATEGIES:

-  Use the metric system in calculating the results of a laboratory experiment.
-  Identify the relationships found on tables, charts and graphs.
-  Graph orders of magnitude in association with large and small quantities.

**INSTRUCTIONAL STRATEGIES:** (cont'd)

-  Explain the value of coefficients and subscripts in balancing equations.
-  Measure lengths, mass, volume and temperature using SI units.  $\Delta$
-  Practice writing a whole number as a fraction, decimal and percentage.

***Teacher Comments:***

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## 5. MOTION AND FORCES (Introduction)





























**CORE CONTENT:** Topics should include, but not be limited to:

- Universal Law of Gravitation
- speed – velocity, acceleration, deceleration, terminal velocity, momentum
- equilibrium, friction
- Newton’s Laws of Motion (I, II, III)
- simple machines
- effort force, resistance force, mechanical advantage
- Bernoulli’s Principle










### ASSESSMENT STRATEGIES:

-  Research the work of Sir Isaac Newton and his Universal Law of Gravitation. Give an oral report on how his work helped people to understand force and motion. ☺  
-  Research some favorite amusement park thrill rides and discuss how gravity affects the ride. ☺ 
-  Research different occupations where knowledge of speed and velocity is important. ☺  
-  Explain why a hockey puck will travel faster and farther on smooth ice as compared to traveling on a road surface.
-  Invent a new machine, while working in cooperative groups, that uses at least three simple machines. Make a diagram and name the new machine. Write an essay about what the machine does.  
-  Cut out magazine pictures of machines that are based on simple machines. Circle the simple machine in each picture
-  Explain how simple machines were used in building the pyramids 4,000 years ago.  

## INSTRUCTIONAL STRATEGIES:

-  Invite Sir Isaac Newton to the classroom to explain gravitational force and his Universal Law of Gravitation. (Students can dress in costume.)  
-  Explain why tides are stronger when the sun and moon are in line. Use diagrams or draw a picture showing how the gravitational forces of the sun and moon act together to pull on the surface waters of the earth in the same direction.
-  Imagine that you rolled a ping-pong ball down a bowling alley at a speed of 6 meters per second. Discuss what the ping-pong ball does as it hits the pins. Compare this to a bowling ball moving at 6 meters per second and what it does as it hits the pins. Explain why the impact of the ping-pong ball differs from that of the bowling ball.
-  Roll toy cars over various surfaces, e.g. *wax paper, tabletop, sandpaper, and cement floor*, a distance of one meter. Complete a lab report and graph the results.  
-  Explain how the ability to determine the correct velocity is important to airplane pilots and ship captains who must arrive at their destinations on a schedule and conserve fuel. (Be sure to stress to students that the direction of velocity can be up or down, east or west, north or south.) 
-  Show examples of Newton's Laws of Motion using a laser disk or CD-ROM.  
-  Explain that changes in velocity are either acceleration or deceleration. 
-  Identify several examples of how friction plays a part in everyday life. 
-  Brainstorm with the students about how simple machines make life easier. 
-  Research at least five of the most important machines from 1950 to the present. Report findings to the class.    
-  Discuss and demonstrate the six simple machines using a variety of toys. 
-  Provide students with a smooth board, books, spring scale, to determine how a ramp can help them do work. 

## INSTRUCTIONAL STRATEGIES: (cont'd)








-  Identify the relationships between the forces involved in mechanical advantage and figure out the formula for determining mechanical advantage. Calculate the actual mechanical advantage of the ramp.  $\Delta$
-  Explain compound machines. Discuss why a bike, scissors, tape dispenser, and pencil sharpener are compound machines. Collect pictures of compound machines used in everyday life. 
-  Explore the cartoon work of Rube Goldberg who designed complicated devices to perform simple tasks.  
-  Provide students with materials (e.g. ping pong balls, string, index cards) to investigate Bernoulli's Principle.  

## 6. ENERGY AND ITS INTERACTION WITH MATTER (Introduction)















**CORE CONTENT:** Topics should include, but not be limited to:

- Law of Conservation of Energy
- types of energy
  - kinetic
  - potential
- forms of energy
  - solar, nuclear, mechanical, electrical, chemical, radiant (heat, light)
- heat and conduction
- characteristics of waves
  - sound waves
  - light waves
  - reflection
  - refraction
- electricity, magnetism

### ASSESSMENT STRATEGIES:

-  Explain potential energy and kinetic energy using a roller skater descending a hill.
-  Explain the type of energy that takes place as an object falls off a table.
-  Explain why placing a metal knife in a glass before pouring hot water into it may prevent the glass from breaking.
-  Research and write a report about the need for expansion joints on a bridge.  
-  Explain why metals are good conductors of both heat and electricity.
































## ASSESSMENT STRATEGIES (cont'd)

-  Describe three ways in which magnetism and electricity are similar.
-  Make models or pictures to show the magnetic properties of the earth. Label the north magnetic pole, the north geographic pole, and the earth's magnetic field.
-  Explain what causes electric current to flow. 🌀
-  Explain how a moving ambulance siren exhibits the Doppler Effect.
-  Research how waves are used in medicine, industry, and communication. 📺 🎧 😊
-  Describe how bats use sound waves of very high frequency to find their way and locate prey.
-  Create a series of diagrams that illustrate how sound waves travel through matter.
-  Explain how light is reflected, refracted, or absorbed when it interacts with matter and how color appears as a result of this interaction.
-  Explain three kinds of electromagnetic waves and how each affects people.
-  Research and give an oral report on the development of x-rays. 📺 🎧
-  Explain what makes solar energy a desirable energy source. 📺
-  Explain how life would be different if electric plants and oil wells suddenly stopped working. 😊 🌀
-  Explain the difference between nuclear fission and nuclear fusion.
-  Compare energy production in a traditional power plant and in a nuclear power plant. Which would you prefer? Defend your choice. 🎧 📺 😊

## INSTRUCTIONAL STRATEGIES:

- ✍ Explain the Law of Conservation of Energy. 📖
- ✍ Discuss potential energy and kinetic energy present when a person uses a bow and arrow.
- ✍ Explain how heat travels across space or through materials from warmer objects to cooler ones until both are at the same temperature. 🌡️
- ✍ Demonstrate how most substances expand when heated and contract when cooled, using the metal ball and ring apparatus. Discuss what happens to water when it freezes. 🌡️
- ✍ Develop a display showing the three ways in which heat can be transferred, i.e., conduction, convection, and radiation
- ✍ Provide materials for students to investigate magnetism. Record their observations.
- ✍ Discuss the important contributions of Hans Christian Oersted. 🧲
- ✍ Discuss the importance of electrical safety in everyday life. 😊
- ✍ Demonstrate how electricity can be used to produce heat, light, and sound. 📖
- ✍ Construct a simple electroscope to investigate static electricity. 📖 △
- ✍ Brainstorm the impact that the use of electricity has had on the lives of people during the past century. 📖 🧲 😊
- ✍ Discuss what happens when pebbles are dropped into water. 📖
- ✍ Investigate the differences between transverse and longitudinal waves using ropes and Slinkys. 😊
- ✍ Explain how speed, frequency, and wavelength are related. 🌡️

## INSTRUCTIONAL STRATEGIES: (cont'd)

-  Demonstrate how sound can be produced by vibrating objects and how the pitch of the sound depends on the rate of vibration. 
-  Explain the speed of sound and the factors that affect the speed of sound. 
-  Explain what happens when you strike a tuning fork and touch the vibrating fork to the surface of water. 
-  Explain how sound waves and electromagnetic waves differ. 
-  Discuss how optical fibers use light waves to carry signals and messages.  
-  Distinguish between reflected and refracted light. Explain why a pencil looks broken when placed in a glass of water. 
-  Investigate sources of light and show how light behaves when it strikes different surfaces.
-  Make electromagnetic spectrums to view the visible light spectrum using diffraction grating.
-  Measure and determine the angle of reflection of a beam of light using light boxes. 
-  Perform an experiment to determine how color affects heat absorption.
-  Brainstorm what the source of solar energy is and the various ways energy is emitted (visible light, infrared, ultraviolet radiation). 
-  Make a solar collector to heat water. Collect data, explain results, and explain conclusions.   
-  Explain the two kinds of nuclear energy and how energy is released. Discuss the growing demand for energy and how nuclear reactions are one way to meet the demand.   
-  Explain, giving examples, how most mechanical energy is created by burning fuel (wood, coal, oil, natural gas). Discuss the dependence of electric power plants on fuels.  

# *Physical Science*

## *Secondary Level*

### **NSES:** Physical Science, Content Standard B

As a result of activities in grades 9-12, all students should develop an understanding of:

- structure of atoms
- structure and properties of matter
- chemical reactions
- motion and forces
- conservation of energy and increase in disorder
- interactions of energy and matter

### **NJCCCS:**

Standard 5.8

- All students will gain an understanding of the structure and behavior of matter.
- Standard 5.9
- All students will gain an understanding of natural laws as they apply to motion, forces and energy transformations.

### **DIOCESAN STANDARDS:**

- Students will understand the structure and properties of matter.
- Students will demonstrate an understanding of the nature of energy and its interactions with matter.

# *Physical Science*

## *Secondary Level (cont'd)*

**OUTCOMES:** By the end of twelfth grade students will be able to:

### **1. Structure of Atoms:**

- explain how the atomic theory evolved and describe several of the significant experiments involved
- describe the arrangement of electrons around the nucleus of an atom and how that arrangement affects the atom's properties

### **2. Structure and Properties of Matter:**

- use the periodic table to make predictions about the properties of elements and the formation of compounds.
- name and write formulas of compounds
- describe classes of matter and their properties
- explain the forces of attraction that exist between atoms and between molecules and how they affect the properties of the resulting substances

### **3. Chemical and Physical Changes:**

- describe the various states of matter
- distinguish among different types of chemical reactions
- explain how to speed up or slow down a chemical reaction
- show/demonstrate how mass is conserved in a chemical reaction
- discuss various methods of expressing concentration and solubility
- describe, using LeChatelier's Principle, how changes in specific variables affect equilibrium
- perform acid-base titration

# *Physical Science*

## *Secondary Level (cont'd)*

### **4. Math Aspects of Science:**

- use the metric system in measurements and calculations. Express numbers with the correct number of significant digits and in proper scientific notation
- balance equations using various methods
- solve problems dealing with moles and mole equations
- determine the percent composition of a compound
- solve pH problems
- describe the variety of geometric shapes found in molecules

### **5. Motion and Forces:**

- use Newton's Laws of Motion to solve problems involving one or more forces on a single mass and then to predict its motion
- explain Newton's Law of Universal Gravitation and its origin and then use it to determine the force of attraction between two objects
- use conservation of mechanical energy to explain the relationships among work, power and mechanical advantage
- discuss electrical forces, the basics of voltage, current and resistance and their use in determining power and Ohm's Law

### **6. Energy and its Interactions with Matter:**

- explain how electromagnetic waves are generated and identify the components of the electromagnetic spectrum
- use the properties of waves (reflection, refraction, interference and diffraction) to predict wave behavior especially with respect to light and sound
- describe the relationship between electricity and magnetism and apply this knowledge to describe how electric motors, generators, electromagnets, and transformers work

# *Physical Science Key Areas and Content Topics*

## *Secondary Level*

### **1. Structure of Atoms:**

- history of modern atomic theory
- parts and properties of an atom
- electron configuration of an atom
- Lewis (electron-dot) structures
- fission and fusion
- radioactive isotopes

### **2. Structure and Properties of Matter:**

- elements, compounds, mixtures, and solutions
- bonding and intermolecular forces of attraction
- patterns in the periodic table including physical and chemical properties
- formulas of compounds

### **3. Chemical and Physical Changes:**

- different types of chemical reactions
- factors affecting rates of reactions
- kinetic molecular theory
- properties of gases
- Law of Conservation of Mass in chemical reactions
- solubility
- chemical equilibrium

# *Physical Science Key Areas and Content Topics*

*Secondary Level (cont'd)*

## **4. Math Aspects of Science: (not limited to)**

- metric system
- scientific notation
- ratios / proportions
- graphing
- use of scientific calculators
- balancing equations
- moles and mole equations
- percent composition
- determining concentration and pH
- stoichiometry
- molecular shapes
- vector analysis

## **5. Motion and Forces:**

- Newton's Laws of Motion
- velocity and acceleration
- force of friction, net force- equilibrium, work, and power.
- two dimensional vectors
- gravity – motion in the heavens
- circular motion

## **6. Energy and its Interaction with Matter:**











- characteristics of waves, electromagnetic spectrum, electricity and magnetism, work and energy, heat, sound, light, Laws of Thermodynamics (reflection and refraction), specific heat, heat and temperature

## 1. STRUCTURE OF ATOMS

**CORE CONTENT:** Topics should include, but not be limited to:

- history of the modern atomic theory
- parts and properties of an atom
- electron configuration of an atom
- Lewis (electron-dot) structures
- fission and fusion
- radioactive isotopes

### ASSESSMENT STRATEGIES:

-  Research a scientist from their cultural background who has contributed to a better understanding of chemistry.   
-  Write electron configurations for calcium and barium and determine which is more reactive. Explain why. □
-  Compare and contrast scanning probe microscopes and scanning tunneling microscopes. 
-  Explain the structure and behavior of atoms using models. 
-  Determine how compounds are formed using Lewis (electron-dot) structures.




## ASSESSMENT STRATEGIES: (cont'd)

- 🔦 Identify unknown elements by using the Flame Test.
- 🔦 Develop a presentation demonstrating energy production from the processes of fission and fusion. 📱 📺 😊 🎧
- 🔦 Investigate how radioactive isotopes are used in the medical field. 😊 📱 🧪

## INSTRUCTIONAL STRATEGIES:

- ✍ Discuss the relationship between Dalton's Atomic Theory and Lavoisier's observation that reactants always weigh the same as the products. 🧪
- ✍ Explain atomic structure using a CRT (cathode ray tube), a spectrophotometer, and prisms. 📱
- ✍ Explain the use of the Geiger counter. Randomly draw a variety of items (e.g. M&M's, marbles, counters) to illustrate radioactive decay. 📱 🧪
- ✍ Investigate Bohr's model of the atom and its flaws.
- ✍ Discuss analogies for Heisenberg's uncertainty principle (billiard balls and croquet balls). 🧪
- ✍ Explain why transition metals produce colored compounds. 😊

**INSTRUCTIONAL STRATEGIES:** (cont'd)

-  Invite an art teacher to talk to the class about the chemicals used in paints or glazes to produce desired colors. ☺ ☹
-  Check web site -- <http://almaden.ibm.com/vis/stm/gallery.html> for images of atoms from (STM) microscopes. 🖨
-  Identify elements by using the Flame Test.

***Teacher Comments:***

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

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## 2. STRUCTURE AND PROPERTIES OF MATTER

**CORE CONTENT:** Topics should include, but not be limited to:

- elements, compounds, mixtures, and solutions
- bonding and intermolecular forces of attraction
- patterns in the periodic table including physical and chemical properties
- formulas of compounds

### ASSESSMENT STRATEGIES:















-  Separate mixtures by a variety of processes, such as chromatography, distillation, crystallization and filtration. 
-  Write the chemical formulas and names of various compounds.  $\Delta$
-  Draw structural and electron-dot formulas for compounds.  $\Delta$
-  Assign oxidation numbers to students and allow them to “form” their own compounds.  $\Delta$
-  Determine whether a green dye is a mixture of blue and yellow or a pure green dye.
-  Identify an unknown compound by qualitative analysis. 
-  Describe periodic trends among the elements in the periodic table. 
-  Describe how to prepare a solution. 

### 3. Chemical and Physical Changes





**CORE CONTENT:** Topics should include, but not be limited to:

- different types of chemical reactions
  - five general types
  - oxidation/reduction
  - acid/base, ph
- factors affecting rates of reactions
  - temperature
  - catalysts
  - concentration
  - ph
- kinetic molecular theory
  - states of matter
- properties of gases
- Law of Conservation of Mass in chemical reactions
- solubility
- chemical equilibrium





## ASSESSMENT STRATEGIES:

-  Identify the type of chemical reaction shown in a balanced equation.
-  Write an article about the effects of acid rain on the environment.  ☺
-  Design an experiment to determine if silver will tarnish faster in a clean or polluted environment. ☺ 
-  Explain the redox reactions that occur during a lightning storm. ☹
-  Identify and predict a condition that will affect the rate of a reaction. ☹
-  Explain why salt is placed on an icy sidewalk. ☺
-  Write a report on the relationship of folic acid to birth defects. ☺ 
-  Design an experiment to show which kind of wrap (plastic, wax paper, aluminum foil) is best to store sliced lemons. Why?  ☺
-  Describe a water molecule's position and movement as temperature changes from  $-10$  degrees C to  $+110$  degrees C. (Role play.) ☹
-  Use ratios/proportions to determine changes in physical conditions of gases.  $\Delta$

## INSTRUCTIONAL STRATEGIES:

-  Investigate pH and pH changes during titration.
-  Perform experiments using PASCO or other computer based probes. 
-  Investigate the relationship of pH to colors of hydrangea plants. ☺

**INSTRUCTIONAL STRATEGIES:** (cont'd)

-  Explain why water is sprayed on citrus fruit during the winter to prevent the fruit from freezing even though the water on the fruit freezes. ☺ 
-  Produce solubility curves for various compounds.
-  Determine why limestone is sometimes put into acidic streams. ☺

***Teacher Comments:***

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## 4. MATH ASPECTS OF SCIENCE

**CORE CONTENT:** Topics should include, but not be limited to:

- metric system
- scientific notation
- ratios / proportions
- graphing
- use of scientific calculators
- balancing equations
- moles and mole equations
- percent composition
- determining concentration and pH
- stoichiometry
- molecular shapes
- vector analysis

### ASSESSMENT STRATEGIES:

- ☞ Measure the lengths and masses of wires: length, width and masses of pieces of linoleum; calculate areas of linoleum in order to review metric measurement.
- ☞ Determine the mass of  $6.02 \times 10^{23}$  atoms of an element randomly selected from the periodic table.
- ☞ Determine molar mass through a variety of methods, such as percent composition and freezing point depression.
- ☞ Determine the melting point of a substance by graphing.

## INSTRUCTIONAL STRATEGIES:

- ✍ Use student built models to show balanced equations.
- ✍ Show students six (6) of each of the following: oranges, grapes and melons. The number/half dozen is the same but they do not have the same masses. (1mole portions of different substances have different masses.)
- ✍ Learn how to use a scientific calculator to determine quantitative aspects of the CORE CONTENT.
- ✍ Determine the concentration and ph of various solutions through a variety of methods.

## *Teacher Comments:*

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## 5. MOTION AND FORCES


















**CORE CONTENT:** Topics should include, but not be limited to:

- Newton's Laws of Motion
- velocity and acceleration
- force of friction, net force – equilibrium, work and power
- two dimensional vectors
- gravity – motion in the heavens
- circular motion

### ASSESSMENT STRATEGIES:

-  Investigate the transfer of momentum between dynamics carts, equal and unequal in mass and velocity.  $\triangle$
-  Analyze the motion of a bubble rising in a liquid-filled tube using equations and graphs.  $\triangle$
-  Analyze the motion of a ball rolling down a ramp using equations and graphs.  $\triangle$  
-  Calculate the work done and power exerted by students climbing stairs.  $\triangle$
-  Draw a scale drawing of a journey of several stages with its final displacement using a town map.  $\triangle$  

## INSTRUCTIONAL STRATEGIES:









-  Show that a planet sweeps out equal areas in equal times using a chart of the heavens.   
-  Demonstrate the centripetal force exerted on a mass moving in a circle; show that it is equal to the force required under static conditions to elongate a spring.
-  Obtain quantitative information about the motion of an object using a tape or electronic timer. 
-  Construct a pulley system (block-and-tackle) to multiply the effort force in lifting heavy objects. Determine the mechanical advantage the system provides. 
-  Demonstrate how inclined planes provide a mechanical advantage as simple machines.  
-  Combine spring balance and friction blocks to explore the factors that affect friction.
-  Use a force table to provide data required to solve two-dimensional vectors. 
-  Use a centripetal force apparatus to study circular motion. 

## 6. ENERGY AND ITS INTERACTION WITH MATTER








**CORE CONTENT:** Topics should include, but not be limited to:

- characteristics of waves
- electromagnetic spectrum
- electricity and magnetism
- work and energy
- heat
- sound
- light, reflection and refraction
- Laws of Thermodynamics
  - specific heat
  - heat and temperature

### ASSESSMENT STRATEGIES:

-  Construct a graph indicating the energy changes involved as a substance changes from the solid to gaseous state. Calculate the energy that must be added.  $\triangle$  
-  Describe examples of Newton's Laws of Motion. (e.g. removing a tablecloth without removing the dishes first.)  
-  Trace the effect of lenses and mirrors on the rays of light emitted by a ray box.
-  Construct simple circuits.  $\triangle$
-  Identify an unknown by determining its specific heat.  $\triangle$

## INSTRUCTIONAL STRATEGIES:

-  Sketch the electric fields around objects; note the similarity to magnetic fields.
-  Study wave behavior using a slinky; sketch longitudinal and transverse waves; predict their behavior after reflection, transmission and interference. ☺
-  View a video on the collapse of the Tacoma Narrows Bridge; state how resonance contributed to the collapse; correlate this to the shattering of a glass by a sound of a certain pitch. ☺ 📺
-  Show that an engine cannot be 100% efficient but always produces waste heat. △
-  Use computer-based probes to perform experiments. Have students draw their own graphs and perform their own calculations from the data collected, then compare the data with the computer generated ones. △ 📺
-  Determine the wavelengths of the components of the visible spectrum. △
-  Determine the velocity of sound using resonance. △

