Physics
Overview
2022 - 2023

This document is designed to provide parents/guardians/community an overview of the curriculum taught in the FBISD classroom. This document supports families in understanding the learning goals for the course, and how students will demonstrate what they know and are able to do. The overview offers suggestions or possibilities to reinforce learning at home.

Included at the end of this document, you will find:

- A glossary of curriculum components
- The content area instructional model
- Parent resources for this content area

To advance to a particular grading period, click on a link below.

Process Standards

The process standards describe ways in which students are expected to engage in the content. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use knowledge learned efficiently and effectively in daily life.

P.1(A) demonstrate safe practices during laboratory and field investigations
P.1(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials
P.2(A) know the definition of science as specified in chapter 112.39, subsection (b)(2) of 19 TAC
P.2(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence
P.2(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but may be subject to change
P.2(D) design and implement investigative procedures, including making observations, asking well defined questions, formulating testable hypotheses, identifying variables, selecting appropriate equipment and technology, evaluating numerical answers for reasonableness, and identifying causes and effects of uncertainties in measured data
P.2(E) demonstrate the use of course apparatus, equipment, techniques, and procedures, including multimeters (current, voltage, resistance), balances, batteries, dynamics demonstration equipment, collision apparatus, lab masses, magnets, plane mirrors, convex lenses, stopwatches, trajectory apparatus, graph paper, magnetic compasses, protractors, metric rulers, spring scales, thermometers, slinky springs, and/or other equipment and materials that will produce the same results
P.2(F) use a wide variety of additional course apparatus, equipment, techniques, materials, and procedures as appropriate such as ripple tank with wave generator, wave motion rope, tuning forks, hand-held visual spectroscopes, discharge tubes with power supply (H, He, Ne, Ar), electromagnetic spectrum charts, laser pointers, micrometer,

caliper, computer, data acquisition probes, scientific calculators, graphing technology, electrostatics kits, electroscope, inclined plane, optics bench, optics kit, polarized film, prisms, pulley with table clamp, motion detectors, photogates, friction blocks, ballistic carts or equivalent, resonance tube, stroboscope, resistors, copper wire, switches, iron filings, and/or other equipment and materials that will produce the same results
P.2(G) make measurements with accuracy and precision and record data using scientific notation and International System (SI) units
P.2(H) organize, evaluate, and make inferences from data, including the use of tables, charts, and graphs
P.2(I) communicate valid conclusions supported by the data through various methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports
P.2(J) express relationships among physical variables quantitatively, including the use of graphs, charts, and equations
P.3(A) analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student
P.3(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal, articles, and marketing materials
P.3(C) explain the impacts of the scientific contributions of a variety of historical and contemporary scientists on scientific thought and society
P.3(D) research and describe the connections between physics and future careers
P.3(E) express, manipulate, and interpret relationships symbolically in accordance with accepted theories to make predictions and solve problems mathematically

Grading Period 1

Unit 1: Kinematics

Estimated Date Range: August 10 - September 8
Estimated Time Frame: 21 days

Unit Overview: Students will be able to define acceleration, differentiate it with velocity, and give examples of both positive and negative acceleration. Students will be able to differentiate between average velocity and instantaneous velocity; distance and displacement; and speed and velocity. Students will be able to calculate displacement, velocity, and acceleration using the equations of one-dimensional motion. Students will be able to analyze word problems, choose which equation to use and rearrange the equation when appropriate. Students should be able to interpret x-vs. t, v vs. t, and a vs. t plots for both constant velocity and constant acceleration. In 8th grade, students demonstrated and calculated how unbalanced forces change the speed or direction of an object's motion and differentiate between speed, velocity and acceleration.

At home connections:

- With your student, discuss the motion that you make in a vehicle. Discuss speed, direction, accelerating and decelerating, and how this might look on a graph.
- Consider how might the graph be different if traveling in a car, walking, or running?

Concepts within Unit #1 Link to TEA High School Science TEKS	Success Criteria for this concept
Concept #1 Safety and Scientific Processes P.1A, P.2A, P.2A, P.2B	• I can follow all safety rules and procedures during laboratory/field investigations. • I can locate and describe the use of safety equipment.

	• I can correctly identify the waste container, fume hood, recycling container, or any other location within the science lab used for disposal of waste and/or recycling of hazardous or nonhazardous material • I can correctly define the definition of science and how to apply this definition to a variety of sub-disciplines and settings • I can identify and describe the safety precautions and hazards of various chemicals using the Safety Data Sheet (SDS)
Concept #2: Kinematics P.4A, P.4B	• I can describe motion in terms of speed, velocity, distance, and acceleration. • I can draw and graph vectors using the "tail to tip" method to graphically find the vector resultant. • I can compare and contrast speed and velocity. • I can calculate speed and velocity using technology (simulations and photogates). • I can describe and calculate the acceleration (v_f-v_i/Δt) of an object. • I can compare and contrast speed, average velocity, instantaneous velocity, and acceleration. • I can identify and analyze a graph and data tables to determine types of motion.

Unit 2: Projectile Motion and Two-Dimensional Motion

Estimated Date Range: September 9 – October 7
Estimated Time Frame: 20 days

Unit Overview: In this unit, students will be able to describe a projectile as an object upon which the only force acting is gravity. Students will complete a projectile simulation and solve problems that ask for initial velocity and range. Students will work in groups to complete projectile demonstrations. Students will also make the connection to concepts that were taught in 8th grade, unbalanced forces, speed or direction of an object's motion, and acceleration.

At home connections:

- Throw a ball back and forth or watch a football, baseball, or basketball game together. Discuss the shape that the path of the ball makes. Discuss that the ball is traveling in two different directions at the same time, both vertically (as it rises and falls), and horizontally (as it travels toward or away from you).
- Discuss the factors that you think affect how long the ball stays in the air, how far it goes, and what causes the ball to fall.

Concepts within Unit # 2 Link to TEA High School Science TEKS	**Success Criteria for this concept**
Concept #1 Projectile Motion and Two-Dimensional Motion P.4C	• I can differentiate between horizontal velocity and acceleration due to gravity and explain when each one would be used • I can recognize and differentiate between an object's horizontal and vertical components of a projectile motion • I can analyze the motion of a projectile using vertical height, time in air, initial velocity and horizontal range including free falling objects. • I can use equations to calculate projectile motion

Grading Period 2

Unit 3: Newton's Laws of Motion (Dynamics)

Estimated Date Range: October 11 – October 24

Estimated Time Frame: 10 days

Unit Overview:
In this unit, students will explore Newton's First Law of motion by defining inertia and connecting inertia to patterns in natural phenomena on Earth and in space. Students will make calculations using F=ma (Newton's Second Law). Students will explore Newton's Third Law by identifying action-reaction pairs and recognizing how forces make objects move with 'equal and opposite' direction and magnitude. Free body diagrams will be created and analyzed in this unit.

At home connections:

- Consider everyday forces that are applied in your home. When you push a box, lift a book, stir a pot while cooking dinner, walking across the floor, etc. Have your student make a list of examples of force.
- Draw diagrams of the examples of force, discussing the direction of the applied force.
- Discuss forces that are applied while driving/riding in a car.

Concepts within Unit # 3 Link to TEA High School Science TEKS	**Success Criteria for this concept**
Concept #1: Newton's Laws of Motion (Dynamics) P.4D	• I can describe the law of inertia • I can calculate the force acting on an object • I can illustrate forces using a free body diagram • I can define and Identify Newton's three laws of motion • I can calculate F=ma and use it to calculate for constant velocity • I know the difference between mass and weight • I know how to convert back and forth from mass to weight • I can describe Newton's Laws in a physical system • I understand the cause/effect relationship between action/reaction pairs

Unit 4: Gravity and Circular Motion

Estimated Date Range: October 25 – November 4
Estimated Time Frame: 8 days

Unit Overview: In this unit, students will describe the Law of Gravitational Forces and its components and analyze how the mass and distance between two bodies affect the gravitational force between them. Students will calculate the magnitude of gravitational force and describe the inverse square law. While completing a lab investigation students will calculate force, velocity and acceleration of objects in circular motion, distinguish between linear and rotational velocity, differentiate between centripetal and centrifugal forces, as well as determine the direction of force, velocity and acceleration vectors during circular motion.

At home connections:

- Discuss gravity and how it is different on the moon versus on Earth. Watch a video of a hammer being dropped on the moon. Why would the hammer drop slower on the moon than here on Earth?
- Tie an object to the end of a string. Have your student swing the object around in a circle from different spots along the string. For example they might hold the end of the string and swing the object around, then hold half way up the string, then ¾ of the way up the string. What does your student notice about the motion of the object as the length of string changes?

Concepts within Unit # 4 Link to TEA High School Science TEKS	Success Criteria for this concept
Concept #1: Gravity P.5B, P.5A	• I can describe the Law of Gravitational Forces and its components. • I can analyze how the mass and distance between two bodies affect the gravitational force between them • I can describe the inverse square law. • I can algebraically solve for the gravitational force, mass or distance between two objects • I can use an inverse square law to determine the increase or decrease in the force of gravity between two objects of given distance
Concept #2: Circular Motion P.4C	• I can understand that for an object to travel in a circular path, it requires a force acting towards the center of the circular path • I can draw the forces acting on a car during a turn • I can solve the centripetal acceleration of a car if I have knowledge of the forces acting on the car • I can solve for the maximum force of friction required to complete a turn by a car based on the speed of the car and its turning radius • I can draw the forces acting on a ball attached to a string while spinning in a horizontal or vertical plane • I can solve for the speed of an object traveling in a circle if given the object's radius and period • I can solve for the centripetal acceleration of an object based on being given the object speed, period and/or radius

Unit 5: Work, Power, Energy, and Thermodynamics

Estimated Date Range: November 7 – December 16
Estimated Time Frame: 25 days

Unit Overview: In this unit, students will understand that work is done when a force is exerted on an object, and the object moves from one place to another. Work is the result of a force, acting over a certain distance. This distance is called the displacement of the object. The kinetic energy (K) of an object is equal to the amount of work that is required to accelerate the object from rest to a certain velocity. Students will investigate the relationship between kinetic energy and work, which is called

the work-energy theorem. Students will calculate work and power of a system. Students will also describe and analyze the laws of thermodynamics.

At home connections:

- Explore your electricity bill together. How does the use of light fixtures and appliances in your home affect your electric bill?
- Check the power rating on small appliances such as the microwave and hair dryer. Notice that the power rating is in the unit of Watts. What are the pros and cons to these appliances having higher or lower power ratings?

Concepts within Unit # 5 **Link to TEA High School Science TEKS**	**Success Criteria for this concept**
Concept #1 Work, Power, and Energy P.6A, P.6D, P.6B, P.6C	• I can differentiate between potential and kinetic energy and provide everyday examples of each type • I can provide examples using everyday examples of heat energy transfer • I can explain the law of conservation of energy and how it applies in new situations. • I can explain how the law of conservation of energy is evident during investigations. • I can explain that a system's total energy is conserved, although, within the system, energy is continually transferred from one object to another and between its various possible forms. • I can explain how energy is conserved in a closed system. • I can identify and explain how energy is transferred from one form to another using real-world examples. • I can identify and describe different forms of energy
Concept #2: Thermodynamics P.6E	• I can explain how the transfer of thermal energy operates both within a system and outside of a system • I can explain the process of thermal energy transfer • I can identify everyday examples of the four laws of thermodynamics

Grading Period 3

Unit 6: Momentum and Impulse

Estimated Date Range: January 5 – January 25
Estimated Time Frame: 14 days

Unit Overview: In this unit, students will calculate the momentum of an object in one-dimension. During laboratory experiments students investigate the relationship between momentum and impulse and calculate the total momentum of a closed system for an elastic or inelastic collision. This is the first time students will experience the concept of momentum and impulse.

At home connections:

- Watch a video of vehicle crash tests. Discuss how the collision of a vehicle compares to the collision of a basketball bouncing off of a brick wall. Why might these be considered two different types of collisions?

Concepts within Unit # 6 Link to TEA High School Science TEKS	Success Criteria for this concept
Concept #1 Momentum and Impulse P.6D, P.6C	• I can describe momentum. • I can calculate momentum (p=mv). • I can calculate the components of momentum for an object moving in one dimension • I can identify the difference between elastic, inelastic, and perfectly elastic collisions using examples and non-examples • I can calculate the momentum of a system. • I can explain the relationship between impulse and momentum • I can explain impulse using real life examples • I can calculate impulse delivered to an object when given a scenario.

Unit 7: Electrostatics

Estimated Date Range: January 26 – February 10
Estimated Time Frame: 12 days

Unit Overview: In this unit, students will describe Coulomb's Law and its components. Students will investigate the effects of attractive and repulsive electrical forces between two objects. Students will also differentiate between conductors and insulators as well as calculate the magnitude of the electrical force between two point charges. This is the first time students will experience the concept of electrostatics.

At home connections:

- Vigorously rub a balloon across carpet, fur, or human hair. Attempt to attach the balloon to the wall. If you have created enough static electricity, the balloon will stick. Have your student draw what they think is happening in this scenario using protons and electrons.

Concepts within Unit # 7 Link to TEA High School Science TEKS	Success Criteria for this concept
Concept #1 Electrostatics P.5C, P.5D	• I can understand that a magnetic field is generated around an electrical current and that the motion of a conducting wire through a magnetic field generates a current through it. • I can understand that in some substances, such as metals, electrons flow easily, whereas in insulating materials such as glass they can hardly flow at all. • I know that at very low temperatures, some materials offer no resistance to the flow of electrons and become superconductors.

	• I understand that an electrically neutral object has particles within it that are charged, but their charges balance each other out. • I understand that the electrical force is a universal force that exists between any two charged objects. Opposite charges attract, like charges repel. • The strength of the force is proportional to the charges, and, like gravity, it is inversely proportional to the square of the distance between the charged bodies. • Understand that between any two charged particles, the electrical force is vastly greater than the gravitational force. Most observable forces such as those exerted by a coiled spring or friction may be traced to electrical forces acting between atoms and molecules. • Compare and contrast Coulomb's Law and Newton's Law of Gravitational Constant • Perform calculations, using Coulomb's Law and Newton's universal law of gravitation • Understand that a magnetic field is generated around an electrical current and that the motion of a conducting wire through a magnetic field generates a current through it. • Describe how capacitance is related to the charge and voltage of a capacitor • Understand when mechanical work is done in an electrical system • Know when voltage and current will vary in an AC circuit • Know how an electric motor is related to an electric generator

Unit 8: Electric Circuits

Estimated Date Range: February 13 – March 10
Estimated Time Frame: 18 days

Unit Overview: In this unit, students will compare parallel and series circuits. During a laboratory, investigation students will construct a parallel and series circuit and explain the transfer of electrical energy. Students will also be able to explain the relationship between electricity and magnetism.

At home connections:

- Consider how the wiring in your home is set up. Discuss what would be different in the kitchen if your home was wired in series rather than in parallel.

Concepts within Unit # 8 Link to TEA High School Science TEKS	Success Criteria for this concept
Concept #1 Electric Circuits P.5F, P.5E	• List the characteristics of a parallel circuit. • List the characteristic of a series circuit • Create each type of circuit given basic materials like batteries, wires, switches etc. • Describe how electricity moves through each type of circuit and what would happen if the pathway was blocked off at certain points. • Use the terms current, voltage and resistance accurately. • Calculate the current, voltage and resistance in a circuit using Ohm's law. • Understand the factors that affect the resistance of a wire • Correctly identify the elements that compose electric circuits

Grading Period 4

Unit 9: Electromagnetism

Estimated Date Range: March 20 – March 31
Estimated Time Frame: 10 days

Unit Overview: In this unit, students will understand the relationship between electricity and magnetism. An electromagnet works on the principle that an electric current not only allows electrons to flow in a circuit, but also generates a small magnetic field. When a wire carrying electricity is coiled, the magnetic field becomes even stronger. Iron or steel objects surrounded by this coiled electric wire also become magnetized. This combination of electronic energy, coiled wiring and conductive metal object forms the basis of an electromagnet. Students will determine the direction of a magnetic field at a given location and calculate the magnetic force of a magnetic field.

At home connections:

- Play with magnets and a compass or an online simulation that uses magnets and a compass. Discuss how the magnets affects the compass.

Concepts within Unit # 9 Link to TEA High School Science TEKS	Success Criteria for this concept
Concept #1 Electromagnetism P.5A, P.5D	• Be able to distinguish between the north and south poles of a magnet • Be able to determine the strength and direction of a magnetic field in a current-carrying wire • Know that the direction of a magnetic field can be determined using the right-hand rule

	• Be able to calculate the magnetic field produced by a current in a wire. • Be able to calculate the amount of magnetic force produced by a magnetic field • Be able to calculate the magnetic flux of a magnetic field

Unit 10:Waves and Optics

Estimated Date Range: April 3 – May 2
Estimated Time Frame: 20 days

Unit Overview: In this unit, students will observe the properties and characteristics of sound. Waves propagate through a medium. The pattern of the sine wave consists of a crest and a trough (or in the case of longitudinal waves, a compression and a rarefaction). The crest can be seen moving along the medium from one location to another location. The speed (or velocity) of a wave is defined as the distance a crest on the wave travels per unit of time. Students will calculate the speed, frequency, or length of a wave and use the Doppler effect to determine frequency during a lab investigation.

Students will observe properties and behavior of light as well as the properties of image formation as it relates to a convex or a concave mirror. Students will utilize the law of reflection to find the angle of incidence or angle or reflection of a ray of light. Snell's law will allow students to find the index of refraction for a ray of light.

At home connections:

- Play with a slinky together sending waves down the spring. Discuss patterns and observations.
- Make waves in a sink or bathtub. Study what happens when two waves come together.

Concepts within Unit # 10 **Link to TEA High School Science TEKS**	**Success Criteria for this concept**
Concept #1 Waves P.7B, P.7D, P.7A, P.7C	• Understand that simple harmonic motion occurs when the restoring force of a spring is proportional to the displacement of the spring from equilibrium. • Understand that the change in the period of a mass on a spring is inversely proportional to the value of the spring constant. • Understand that the change in the period of a mass on a spring will be proportional to that same mass • Calculate the frequency, velocity, and period of a wave • Calculate the period of a pendulum of a given length • Calculate the wavelength and frequency of the first harmonic motion for a standing wave on a string • Correctly identify the differences between a transverse wave and a longitudinal wave • Correctly identify the differences between constructive and destructive interference • Understand that the Doppler effect can change the frequency of light waves • Understand that light behaves like a wave and a particle • Understand that the frequency of light increases when a source is moving toward an observer and decreases when a source is moving away from an observer • Calculate the wavelength and frequency of light using the value for the speed of light in a vacuum • Interpret the properties of electromagnetic waves based upon their wavelength using the electromagnetic spectrum • Understand that additive and subtractive primary colors will combine to produce new colors • Calculate the speed, wavelength, and period of a wave • Understand how to use the principle of superposition to describe constructive and destructive interference.

	• Identify the node and antinode for a standing wave • Identify the first, second, and subsequent harmonic frequencies for a wave • Identify the type of electromagnetic wave based upon its location on the electromagnetic spectrum • Calculate the frequency or wavelength of visible light • Calculate the beat frequency of two corresponding waves • Determine the pitch of a sound using its characteristic frequency
Concept #2: Optics P.7E	• Understand that the difference in path length of light at a given point will determine the location of constructive or destructive interference • Understand the length of a wave of light will determine the degree of diffraction • Understand that diffraction of light through the pupil of the eye will limit the resolving power of the eye • Calculate the angle of incidence or angle or refraction for a given material using Snell's Law • Calculate the focal length of a convex or concave mirror • Calculate the magnification of an image of a given distance and height

Unit 11: Quantum, Atomic, and Nuclear Physics

Estimated Date Range: May 3 – May 25
Estimated Time Frame: 17 days

Unit Overview: While studying concept 1 - Nature of Light, students will observe the properties and behavior of light. They will also, describe how light can act as both a wave and a particle. During the unit, students will understand the properties/components of the electromagnetic spectrum. Concept 2 – Atomic and Nuclear Physics introduce students to the photoelectric effect. Students will understand the relationship between the wavelength and momentum of a subatomic particle. Physics students will compare and contrast the early models of the atom, understand Bohr's Model of the hydrogen atom, and apply quantum physics to the properties of an atom. Students will also compare and contrast nuclear fission and fusion.

At home connections:

- Discuss with students how they see light, whether they imagine light as a wave or as particles.

Concepts within Unit # 11 **Link to TEA High School Science TEKS**	**Success Criteria for this concept**
Concept #1 Nature of Light P.8A, P.8B	• Understand that a light wave is produced by the movement of an electric and/or magnetic field • Calculate the frequency or wavelength of a ray of visible light using the wave equation • Use the Doppler equation to calculate the change in frequency of a light wave • Identify the types of waves that compose the electromagnetic spectrum • Identify the frequencies and wavelengths of visible and invisible light • Understand that polarization will affect both the intensity and direction of a beam of light
Concept #2: Atomic and Nuclear Physics P.8C	• Use Einstein's photon model of light to explain the photoelectric effect • Calculate the wavelength and momentum of a subatomic particle using the De Broglie Wavelength Equation

	• Calculate the momentum, position, energy, and time of a particle's position using the Heisenberg Uncertainty Principle • Know that the Rutherford model of the atom depicted the atom as mostly empty space with negatively-charged electrons orbiting an extremely small but massive nucleus • Understand that the Bohr Model of the hydrogen atom depicted electrons having specific orbits with specific radii and energies • Calculate the wavelength of a photon emitted by a hydrogen atom using Planck's constant • Determine the number of protons, neutrons, or electrons for an atom of a given element • Explain the difference between nuclear fission and nuclear fusion • Calculate the time required for half of the nuclei in a sample of radioactive material to decay

Glossary of Curriculum Components

Overview– The content in this document provides an overview of the pacing and concepts covered in a subject for the year.

TEKS – Texas Essential Knowledge and Skills (TEKS) are the state standards for what students should know and be able to do.

Unit Overview – The unit overview provides a brief description of the concepts covered in each unit.

Concept – A subtopic of the main topic of the unit.

Success Criteria—a description of what it looks like to be successful in this concept.

Parent Resources

The following resources provide parents with ideas to support students' understanding. For sites that are password protected, your child will receive login information through their campus.

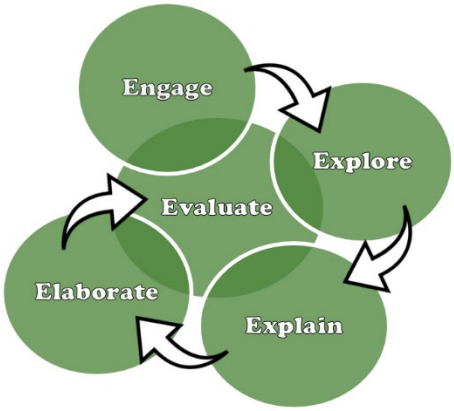
Resource	How it supports parent and students
Pearson Physics by James S. Walker https://www.fortbendisd.com/Page/92908	This is the state adopted textbook for Physics. Click on the link for directions on accessing the textbook.
Khan Academy	This resource contains practice exercises, instructional videos, and a personalized learning dashboard where students can learn and study at their own pace.
Texas Gateways	This online resource contains lessons, videos, and interactive activities for various science concepts.
NSTA – Science Resources for Parents	This online resource has science activities for high school students and their families to help support learning at home.
NOAA – National Oceanic and Atmospheric Administration	This resource is contains videos, images, interactive media, graphics and data related to the ocean and atmosphere.

Supplemental Resource and Tool designation

TI-Nspire Calculator	This calculator is a standardized technology integration tool used for Science and Mathematics in FBISD.

Instructional Model

The structures, guidelines or model in which students engage in a particular content that ensures understanding of that content.



- It is based on the constructivist learning theory, which states that learners build or construct new ideas based on their experiences.
- It represents a recursive cycle of cognitive stages in inquiry-based learning.
- Stages are intended to be completed sequentially; however, you may revisit a stage more than once during the 5E process.
- It capitalizes on hands-on activities, students' curiosity, and academic discussion among students.
- Typically, **NOT** all five stages would be experienced in a single classroom period, but all five would certainly be embedded in a series of lessons that would develop a particular concept, lasting days or weeks.
- It should be used to develop conceptual understanding over time with each stage building on the previous stage, rather than serve as a series of activities.
- It should be used in conjunction with other instructional strategies such as writing in science, graphing, graphic organizers, collaboration, etc.