6th Grade

Developing and Using Models

- Develop and/or use a model to describe and predict observable and unobservable science events
- Develop a model to generate data and test ideas

What should the students know	What should the students be able to do
Atomic Structure. ● 3 subatomic particles and their electrical charge(s). ● Atoms as smallest units of matter ● All matter is made of atoms ● Electrons have more energy the further they are from the nucleus. ● Makeup of the nucleus	**Atomic Structure** ● Construct a scientific model of a an atom representing the correct number and position of electrons, neutrons, and protons. ● Draw parallels between the behavior of electrons in their energy levels and the behavior of people playing 'Fun With Atoms'. ● Develop models demonstrating the two ways in which atoms bond.
Chemistry/Observation ● There are two types of change: a chemical and physical	**Chemistry/Observation** ● Identify and record subtle differences between substances through close observation of physical and chemical traits. ● Compare observations in order to analyze and determine if components of mixtures.
Transfer of Energy/Waves ● There are two different types of waves. ● Waves are energy being transferred. ● Electromagnetic spectrum ● Basic forms of energy (some) by name, not necessarily by definition. ● The relationship between wavelength, energy, and frequency.	**Transfer of Energy/Waves** ● Build a model of the human eye to help explain what happens to light as it travels through it. ● Construct a marble run that successfully fulfills specific criteria relating to laws of force and motion. ● Create a 'running' spectrum as it is being studied, adding detail and elaboration from class discussions and other sources used. Illustrate.
Electricity ● Electricity is electrons. ● Static electricity ● Electrons require a circuit in order to conduct electricity. ● Magnetism and electricity create electromagnetism which increases the strength of the magnet. ● Parallels and series circuits	**Electricity** ● Draw a detailed teaching aid that explains lightning ● You and a partner 'be' a balloon and a head of hair and play out, with dialogue, how the balloon ends up sticking to a wall. ● Build a motor combining electricity and magnetism to cause rotation of a shaft. ● Compare (chart) the strength of a magnet before and after being changed to an electromagnet. ● Create a model that demonstrates how electric current transfers through a complete circuit, lighting a bulb and turning a motor.
Force and Motion ● Newton's Three Laws ● The vocabulary of force and motion ● Formulae for momentum and average speed. ● Measuring and weighing	**Force and Motion** ● In groups of five, build a marble coaster with specific structural criteria. ● Successfully demonstrate working knowledge of vocabulary. ● Keep a running troubleshooting journal using the vocabulary required before construction. ● Make required measurements to compute

Photosynthesis ● Plants carry out photosynthesis.	momentum and average speed of marble as it travels through the coaster. Of **Photosynthesis** ● Draw a detailed, pictorial diagram of the energy transfer and chemical changes during photosynthesis.

Planning and Carrying Out Investigations

- Plan an investigation individually and in groups
- Identify independent and dependent variables and controls
- Determine tools needed to gather data
- Determine what measurements will be recorded and how much data is needed to support a claim.
- Carry out an investigation producing data that serves as evidence that meets the goals of the investigation.

What should the students know	What should the students be able to do
Atomic Structure ● Atoms react to each other in varying ways. ● Obtain data from the Periodic Table of Elements	**Atomic Structure** ● Identify the patterns in the numbers for the individual elements and then use them as 'blueprints' for drawing scientific models of any atom.
Chemistry/Observation ● Lab safety and procedures ● A detailed note taking during investigations ● Communications with partner for optimal detail collection	**Chemistry/Observation** ● By close examinations and analyses of a variety of powders and their reaction to various tests, students can determine components of a mixture of powders.
Transfer of Energy/Waves ● The amount of energy being transferred is affected by the frequency which is a result of wavelength.	**Transfer of Energy/Waves** ● Using a long spring, demonstrate the relationship between frequency and wavelength. Using a timer, make a table of the results and represent in graph form. ● Using tuning forks, hypothesize (supported) the effect of energy transferred to water based on the length and thickness of the forks. Compare your predictions to results.Develop a plausible explanation
Electricity ● Electrons require a circuit ● How to build an electrical switch ● Wattage and voltage ● Parallel and series circuits ● Watts, amperes, and volts	**Electricity** ● Determine the amount of voltage needed to light various bulbs using a combination of batteries. ● Develop a presentation that explains the relationship between watts, amperes, and volts.

Force and Motion ● Formulae for momentum and average speed of an object	**Force and Motion** ● Upon completion of the marble run, time and weigh the marble, measure the track in order to calculate the momentum and average speed of the marble. ● Devise a solution for accurately measuring a long, curving track.
Photosynthesis ● Plants carry out photosynthesis.	**Photosynthesis** ● Work with a partner to research and then present detailed information about the sun's energy being transformed into glucose. Use a labeled diagram to support your team information.

Obtaining, Evaluating, and Communicating Information

- Integrate research-based information with information from mainstream media to clarify scientific claims and findings.
- Gather, read, and bring together information from multiple appropriate sources
- Assess the credibility, accuracy, and possible bias of each publication and methods used
- Describe how the information is supported or not supported by evidence

What should the students know	What should the students be able to do
Atomic Structure ● The difference between scientific and physical models ● The necessity of both. ● Early Greek theories about 'atomos'	**Atomic Structure** ● Find and compare multiple sources of information about the distance between the nucleus and first energy level of an atom. ● Hold a discussion about the believability of atomic models as support for atomic theory.
Chemistry/Observation ● Ancient alchemy ● Fairy tales	**Chemistry/Observation** ● Investigate fairy tales with the belief that base materials could be turned into gold. ● Recognize and discuss the role of alchemists in early history and why Kings had them in their employ.
Transfer of Energy/Waves N/A	**Transfer of Energy** N/A
Electricity ● Electric cars	**Electricity** ● Research and then debate the virtues of electric cars vs. petroleum powered cars.
Force and Motion ● Newton's Laws	**Force and Motion** ● Compare statistics for the world's tallest and/or fastest roller coasters then research current findings on safe levels of g-forces and centrifugal force.

Photosynthesis N/A	**Photosynthesis** N/A

Engaging in Argument from Evidence

- Construct, use, and present oral and written arguments
- Support or refute the argument with research-based evidence and scientific reasoning
- Evaluate and discuss different design solutions based on its design criteria

What should the students know	What should the students be able to do
Atomic Structure ● Cloud, pudding and Bohr's atom models ● The relative distance between the nucleus and first energy level is vast...yet immeasurably small. ● Hiroshima and Nagasaki were bombed with atomic bombs.	**Atomic Structure** ● Explain the advantages and weaknesses of each type of model. ● Discuss the conundrum of the atom's measurements then form an analogy (ie.solar system). ● After reading 'Hiroshima' (Yepp), defend and support the use of atomic devices to end a war.
Chemistry/Observation ● Science is grounded in keen observation. ● Variables must be controlled. ● Taking precise notes records experiences. ● Anecdotal records require adjectival richness.	**Chemistry/Observation** ● As the students progress through their investigations, note taking must be sufficient to support (or refute) hypotheses. ● Compare and discuss different running note taking styles and techniques with classmates.
Transfer of Energy/Waves ● Mediums impact how waves transfer energy ● Frequency and wavelength determine amount of energy being transferred.	**Transfer of Energy/Waves** ● Conduct an investigation in which waves are transferred through a variety of mediums. Record the wps on a table and bar graph the results. ● Develop and defend a plausible explanation for wave investigation results (see Planning and Carrying Out Investigations).
Electricity ● Basic understanding of current and static electricity.	**Electricity** ● Read and debunk ' Theory of the Dark'. All points must be supported by cited evidence from notes and handouts from class.
Fore and Motion ● Newton's Laws ● Working knowledge of unit vocabulary	**Force and Motion** ● Identify, diagnose (troubleshoot) and remedy problems in the marble coaster process, supporting and journaling your thinking and outcomes.Refine your explanations by applying appropriate/specific vocabulary.
Photosynthesis ● Basic working knowledge of photosynthesis	**Photosynthesis** ● Using a directional diagram, trace the processes (cause and effect) of the production of glucose in plants.

Constructing Explanations and Designing Solutions

- Construct a scientific explanation based on evidence obtained from multiple sources, scientific theories, and laws

What should the students know	What should the students be able to do
Atomic Structure ● Basic structure of the atom (3 subatomic particles) ● The electric charges of the protons, neutrons, and electrons ● Atoms are made of mostly empty space. ● The energy of the universe is held in the nucleus of an atom.	**Atomic Structure** ● In an essay, expound (supported) the brilliant balance and essential interplay between + and - charges in the atomic system...Universe. ● In an essay, explain why, if all electrons stopped moving, objects would cease to exist except as microscopic piles of protons and neutrons that would weigh as much as the object did, ie. your house.
Chemistry/Observation ● Heat increases the energy of electrons, causing physical and/or chemical change.	**Chemistry/Observation** ● Chronicle the cause and effect relationship between heat and chemical and/or physical change based on the Mystery Powder experience (cited from your lab notes).
Transfer of Energy/Waves ● Higher frequency/shorter wavelengths generate more energy. ● Law of Conservation of Energy	**Transfer of Energy/Waves** ● Explain the effects of different the tuning forks had on the water. ● Hypothesize the pitch change on a guitar or violin (piano etc.) string. ● Formulate a logical explanation for how we make high to low pitches. Hypothesize the design. ● Make the connection between the energy required in order to generate energy in a long spring.
Electricity ● Working knowledge of static electricity; ● Opposite charges attract, same charges repel.	**Electricity** ● Hypothesize (predict) outcomes by applying principles of static electricity gleaned from previous investigations (of static) and study.
Force and Motion ● Natural and manmade objects utilize support systems.	**Force and Motion** ● Observe buttressing systems in nature and architecture and develop a system to help support and strengthen your coasters.
Photosynthesis ● Basic knowledge about photosynthesis	**Photosynthesis** ● Research capillary action and investigate with capillary tubes then explain to a partner how plants are able to pull water up from the ground. ● Students will work in small groups to brainstorm

	a possible application of capillary action in our bodies and then design it.

Analyzing and Interpreting Data

- Analyze and interpret data to determine similarities and differences
- Construct and interpret graphs of data to identify relationships.

What should the students know	What should the students be able to do
Atomic Structure ● The Periodic Table shows discrepancies. ● The heavier the atom, the more unstable/reactive it is.	**Atomic Structure** ● Identify discrepancies in the patterns and determine a generalization about them.
Chemistry/Observation ● There are two kinds of change:chemical and physical. ● Heat excites electrons.	**Chemistry/Observation** ● Using your Mystery Powder lab notes, determine which powders experienced chemical changes. ● List what you believe to be consistent 'markers' or indicators for chemical change.
Transfer of Energy/Waves ● Frequency/wavelength determine the amount of energy being transferred.	**Transfer of Energy/Waves** ● Time wps, using the big spring, record on a table using time and number of waves generated. ● Graph the data and ascertain the causal relationship between frequency and wavelength.
Electricity N/A	**Electricity** N/A
Force and Motion ● Formula for finding momentum	**Force and Motion** ● Predict (supported) then calculate the momentum of different weight marbles on your coaster. ● Determine what measure(s) changed. ● Explain how a heavier (or lighter) marble will change the momentum on the coaster.
Photosynthesis ● Greenhouse gasses	**Photosynthesis** ● Write an essay explaining the ramifications of methane release in our atmosphere as related to melting icecaps (trapped photosynthetic gasses).

Asking Questions and Defining Problems

- Ask questions and form a hypothesis that can be investigated within the scope of the classroom, outdoor environment, and public resources
- Define a design problem that includes multiple criteria
- Solve a design problem through the development of an object, tool, process or system

What should the students know	What should the students be able to do
Atomic Structure ● The further an electron is from the nucleus, the more energy it has. ● The further an electron is from the nucleus, the weaker the attraction between them.	**Atomic Structure** ● After 'Fun With Atoms', brainstorm a different analogous system that demonstrates the same principle. ● Hypothesize, then research whether or not the outer planets of the solar system travel at greater energy.
Chemistry/Observation ● Taking running lab notes (legible) during procedures and observation. ● Laboratory safety is essential.	**Chemistry/Observation** ● Develop a system (with partner) to verbalize ongoing observations of quickly changing conditions,and getting them recorded. ● Use descriptive (adjectival) language to purvey your observations as concisely as possible. ● Develop a mutual system for safety procedures.
Transfer of Energy/Waves NA	**Transfer of Energy/Waves** NA
Electricity ● Build a kinetic structure with a switch that operates a light and a small motor which may or may not complete a secondary function.	**Electricity** ● Integrate your circuit through the structure. ● Design and build your own switch. ● Mount the motor so that the shaft can move freely and perform a function.
Force and Motion ● Newton's Laws ● Working knowledge of force and motion concepts and principles	**Force and Motion** ● A group of 5 (ideally) rotates through 3 tasks to build a marble run that fulfills a variety of design and performance criteria. ● Keep a trouble shooting journal requiring proposed design solutions. ● Support revisions with valid force and motion principles as demonstrated with the correct application of vocabulary.
Photosynthesis ● Basic photosynthesis ● Greenhouse Effect	**Photosynthesis** ● Design a visual aid that could teach someone the rudimentary principles of the conversion of light to glucose. ● Research and discuss the causes and effects of greenhouse gas pollution and brainstorm hypothetical solutions. ● Participate in a discussion about what 'pro-active' means. ● List the small (or not so small) changes you could make to lessen your 'footprint'.

Using Mathematics and Computational Thinking

- Use mathematical representations to describe and/or support scientific conclusions and design solutions

What should the students know	What should the students be able to do
Atomic Structure ● Basic interpretation of the Table of Elements ● Ionic and covalent bonding	**Atomic Structure** ● Explain the relationship between the ● Atomic Number and the number of electrons. ● Calculate the number of protons and neutrons in the nucleus, and the number of energy levels. ● Based on valence electrons, determine what atoms can bond.
Chemistry/Observation ● Measuring is essential for the elimination of variables in an investigation/experiment.	**Chemistry/Observation** ● Meticulously measure the ingredients as you conduct your investigations. ● Conduct the procedures with as much consistency as possible. ● Explain the importance of consistent practice in the Mystery Powder unit.
Transfer of Energy/Waves ● Measure WPS	**Transfer of Energy/Waves** ● Graph data collected during class investigation of frequency and wavelength, showing the causal relationship between the two.
Electricity NA	**Electricity** NA
Force and Motion ● Build a marble coaster fulfilling the criteria set forth ● Formulae for average speed and momentum ● Measure a long curved track. ● Use a balance scale to the tenth of a gram.	**Force and Motion** ● Calculate the momentum of the coaster. ● Measure the length of the coaster and tie the marble on the coaster, each three time and find the average measure. ● Explain why you are required to make three measurements and average instead of taking a single measurement.
Photosynthesis ● Greenhouse gasses ● Methane release	**Photosynthesis** ● Research global warming and its causes. ● Write a 'call to action' advocating specific research-based changes using cited, statistical support from your research.