"I Can¨
Mascoma High School
Physical Science Curriculum

I Have Good SCIENTIFIC SKILLS

☐ I can observe and ask questions about scientific topics.

☐ I can build and revise a simple model to represent events and design solutions.

☐ I can develop a model to describe or represent scientific phenomena.

☐ I can plan and carry out a scientific investigation to answer a question or solve a problem.

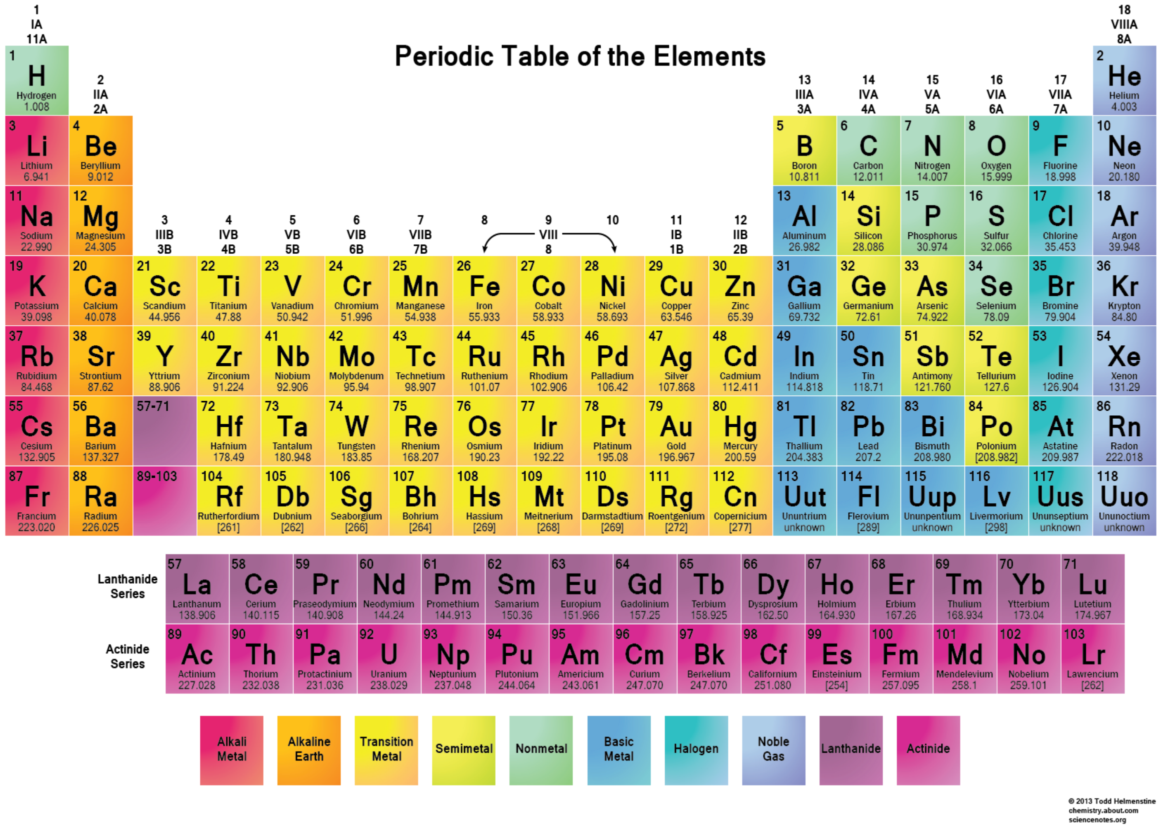
☐ I can produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials is considered.

☐ I can make observations and measurements to produce data to serve as the basis for evidence for the explanation of a phenomenon.

☐ I can measure and graph quantities such as weight and length to address scientific and engineering questions and problems.

☐ I can explain the results of a scientific investigation.

I know about Matter and Its Interactions



☐ I can 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. (Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, number of bonds formed, and reactions with oxygen. Assessment is limited to main group elements and does not include quantitative understanding of ionization energy beyond relative levels).

☐ I can 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. (Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen. Assessment is limited to chemical reactions involving main group elements and combustion reactions.).

☐ I can plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles (Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials, such as graphite. Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension. Assessment does not include Raoult's Law calculations of vapor pressure.).

☐ I can develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy (Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved. Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products).

☐ I can apply scientific principals and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs (Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules. Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature).

☐ I can refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium (Emphasis is on the application of Le Chatelier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products. Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations).

☐ I can use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction (Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic state. Emphasis is on assessing student use of mathematical thinking and not on memorization and rote application of problem-solving techniques. Assessment does not include complex chemical reactions).

☐ I can develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion and radioactive decay (Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations. Assessment is limited to alpha, beta, and gamma radioactive decays).

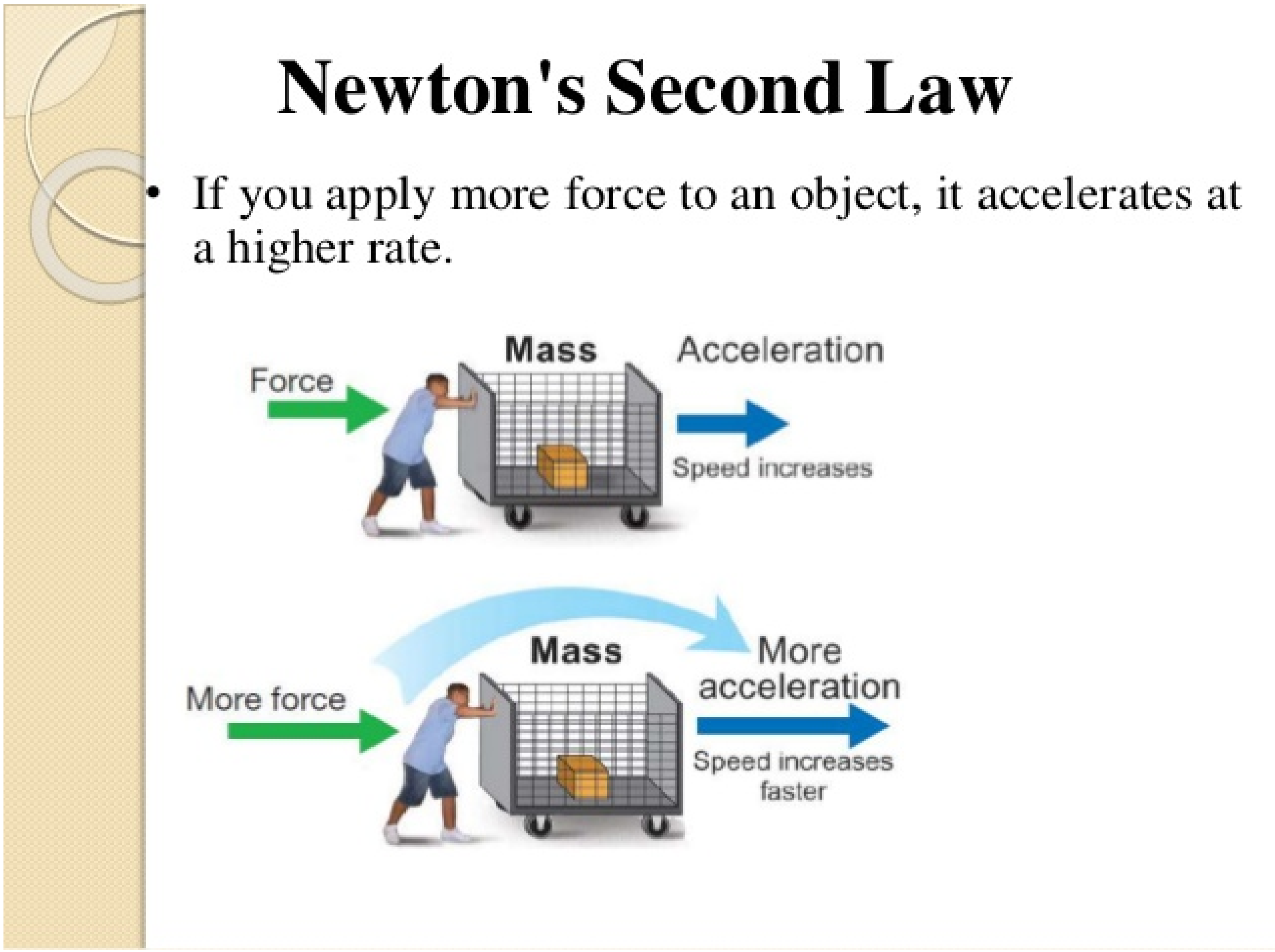
A little primer for my teacher: **Every student is responsible for the blue standards. Only juniors and seniors are responsible for the black standards.**

Mascoma Standards	RIST.9.7- Translate quantitative or technical information expressed in words in a text into visual form (table or chart) and translate information expressed visually or mathematically (in an equation) into words.	RIST.11.1- Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
	WHST.9.2- Write informative/ explanatory texts, including the narration of scientific procedures/ experiments, or technical processes..	WHST.9.5- Develop and strengthen writing as needed by planning, revising, editing, rewriting or trying a new approach, focusing on addressing what is most significant for a specific audience or purpose.
	WHST.9.7- Conduct short, as well as more sustained research projects to answer a question, including a self-generated question, or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.	WHST.11.8- Gather relevant information from multiple print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source, and following a standard format for citation.
	WHST.9.12- Draw evidence from informational texts to support analysis, reflection, and research.	SL.11.5- Make strategic use of digital media (textual, graphical, audio, visual and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence to add interest.
	MP.9.2- Reason abstractly and quantitatively	MP.9.4- Model with mathematics
	HSN.Q. A.9.1- Use units as a way to understand problems and to guide the solution of multi-step problems, choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	HSN.Q. A.9.2- Define appropriate quantities for the purpose of descriptive modeling.
	HSN.Q. A.9.3- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	
Vocabulary	Periodic table, relative properties, elements, energy level, atoms, bonds, reactivity, ionization, nucleus, electron, neutron, proton, combustion, bulk scale,	

	forces, networked material, boiling point, melting point, vapor pressure, surface tension, release, absorption, reactants, products, conservation of energy, temperature, concentration, rate data, molecular collision, variable, macroscopic scale, atomic scale, mole, conversion, fission, fusion, radioactive decay, alpha/beta/gamma radioactive decay
Disciplinary Core Ideas	<u>Structure and Properties of Matter</u> • Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. • The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. • The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. • A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. <u>Chemical Reactions</u> • Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. • In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. • The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved can be used to describe and predict chemical reactions. <u>Nuclear Processes</u> • Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. <u>Structure and Properties of Matter</u> • Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. <u>Optimizing the Design Solution</u> • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others may be needed (trade-offs).
Cross-cutting Concepts	<u>Patterns</u> • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for the causality in explanations of phenomena. <u>Energy and Matter</u> • In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. • The total amount of energy and matter is closed systems is conserved. • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

	<u>Stability and Change</u> • Much of science deals with constructing explanations of how things change and how they remain stable. <u>Scientific Knowledge Assumes and Order and Consistency in Natural Systems</u> • Science assumes the universe is a vast single system in which basic laws are consistent.
Science and Engineering Practice	• Develop a model based on evidence to illustrate the relationships between systems or between components of a system. • Use a model to predict the relationships between systems of between components of a system. • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design; decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (number of trials, cost, risk, time) and refine the design accordingly. • Use mathematical representations of phenomena to support claims. • Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated events. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including student's own investigation, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Refine a solution to a complex, real-world problem, based on scientific knowledge, student generated sources of evidence, prioritized criteria, and trade-off considerations.

I Know About Motion and Stability: Forces and Interactions



☐ I can analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net forces on a macroscopic object, its mass, and its acceleration (Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalance force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds).

☐ I can use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system (Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle. Assessment is limited to systems of two macroscopic bodies moving in one dimension).

☐ I can apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision (Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage, and modifying the design to improve it. Examples of a device could include a football helmet or a parachute. Assessment is limited to qualitative evaluations and/or algebraic manipulations).

☐ I can use mathematical representation of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects (Emphasis is on both qualitative and conceptual descriptions of gravitational and electric fields. Assessment is limited to systems with two objects.).

☐ I can plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. (Assessment is limited to designing and conducting investigations with provided materials and tools).

☐ I can communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. (Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors. Assessment is limited to provided molecular structures of specific designed materials.).

A little primer for my teacher: **Every student is responsible for the blue standards. Only juniors and seniors are responsible for the black standards.**

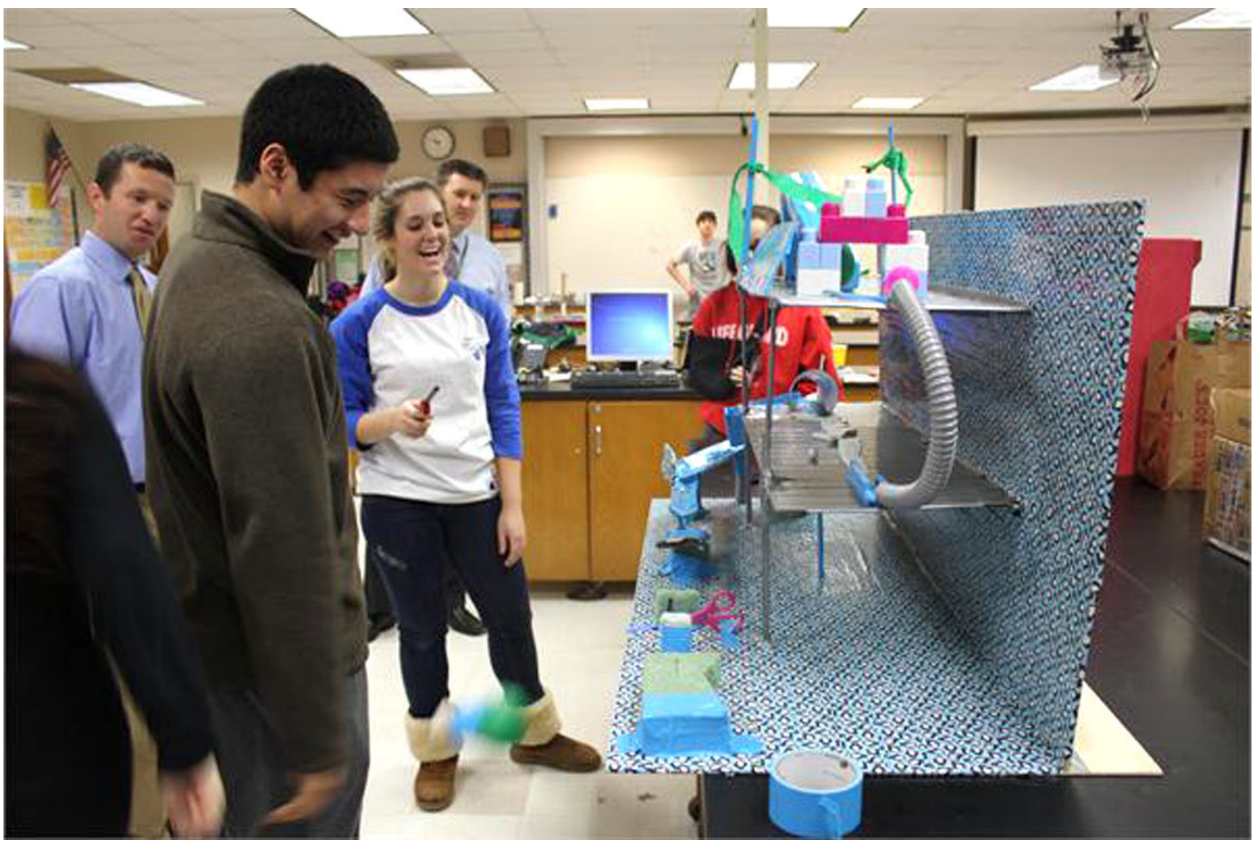
Mascoma Standards	RIST.11.1- Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	RIST.11.7- Integrate and evaluate multiple sources of information presented in diverse formats and media (quantitative, data, video,multi-media) in order to address a question or solve a problem.
	WHST.9.2- Write informative/ explanatory texts, including the narration of scientific procedures/ experiments, or technical processes..	WHST.9.7- Conduct short, as well as more sustained research projects to answer a question, including a self-generated question, or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

	WHST.11.8- Gather relevant information from multiple print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source, and following a standard format for citation.	WHST.9.9- Draw evidence from informational texts to support analysis, reflection, and research.
	MP.9.2- Reason abstractly and quantitatively	MP.9.4- Model with mathematics
	HSN.Q. A.9.1- Use units as a way to understand problems and to guide the solution of multi-step problems, choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	HSN.Q. A.9.2- Define appropriate quantities for the purpose of descriptive modeling.
	HSN.Q. A.9.3- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	SSE. A.9.1- Interpret expressions that represent a quantity in terms of its context.
	SSE. B.9.3- Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.	CED. A.9.1- Create equations and inequalities in one variable and use them to solve problems.
	CED. A.9.2- Create equations in two or more variables to represent relationships between quantities; graph equations on coordinates axes with labels and scales.	CED. A.11.4- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
	IF. C.9.7- Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.	ID. A.9.1- Represent data with plots on the real number line (dot plots, histograms, and box plots).
Vocabulary	Newton's Second Law, net force, mass, acceleration, non-relativistic speed, one-dimensional motion, quantitative conservation, qualitative meaning, Newton's Law of Gravity, Coulomb's Law, gravitational force, electrostatic force, magnetic field, electric current, attractive and repulsive force, pharmaceuticals, specific receptors, bulk scale, risk mitigation	
Disciplinary Core Ideas	Structure and Properties of Matter • A structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. Forces and Motion	

	• Newton's second law accurately predicts changes in the motion of macroscopic objects. • Momentum is designed for a particular frame of reference; it is the mass time the velocity of the object. • If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. <u>Types of Interactions</u> • Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy though space. Magnets or electric currents cause magnetic fields, electric charges or changing magnetic fields cause electrical fields. • Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. <u>Definitions of Energy</u> • "Electrical energy" may mean energy stored in a battery or energy transmitted by currents. <u>Defining and Delimiting Engineering Problems</u> • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. <u>Optimizing the Design Solution</u> • Criteria may be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
Cross-cutting Concepts	<u>Patterns</u> • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. <u>Cause and Effect</u> • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and events. • Systems can be designed to cause a desired effect. <u>Systems and System Models</u> • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. <u>Structure and Function</u> • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
Science and Engineering Practice	• Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and the accuracy of data needed to produce reliable

	measurements and consider limitations on the precision of the data (number of trials, cost, risk, time) and refine the design accordingly. • Analyze data using tools, technologies, and/or models (computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Use mathematical representations of phenomena to describe explanations. • Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. • Communicate scientific and technical information (about the process of development and the design and performance of a proposed process or system) in multiple formats (orally, graphically, textually, and mathematically). • Theories and laws provide explanations in science. • Laws are statements or descriptions of the relationships among observable phenomena.

I Know About Energy



☐ I can 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 (Emphasis is on explaining the meaning of mathematical expressions used in the model. Assessment is limited to basic algebraic expression or computations; to systems of three or less components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electrical fields).

☐ I can develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects) (Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.).

☐ I can design, build, and refine a device that works within given constraints to convert one form of energy to another form of energy (Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency. Assessment is limited to devices constructed with materials provided to students).

☐ I can plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy distribution among the components in the system (Second Law of Thermodynamics) (Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water. Assessment is limited to investigations based on materials and tools provided to students).

☐ I can develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction (Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other. Assessment is limited to systems containing two objects).

A little primer for my teacher:
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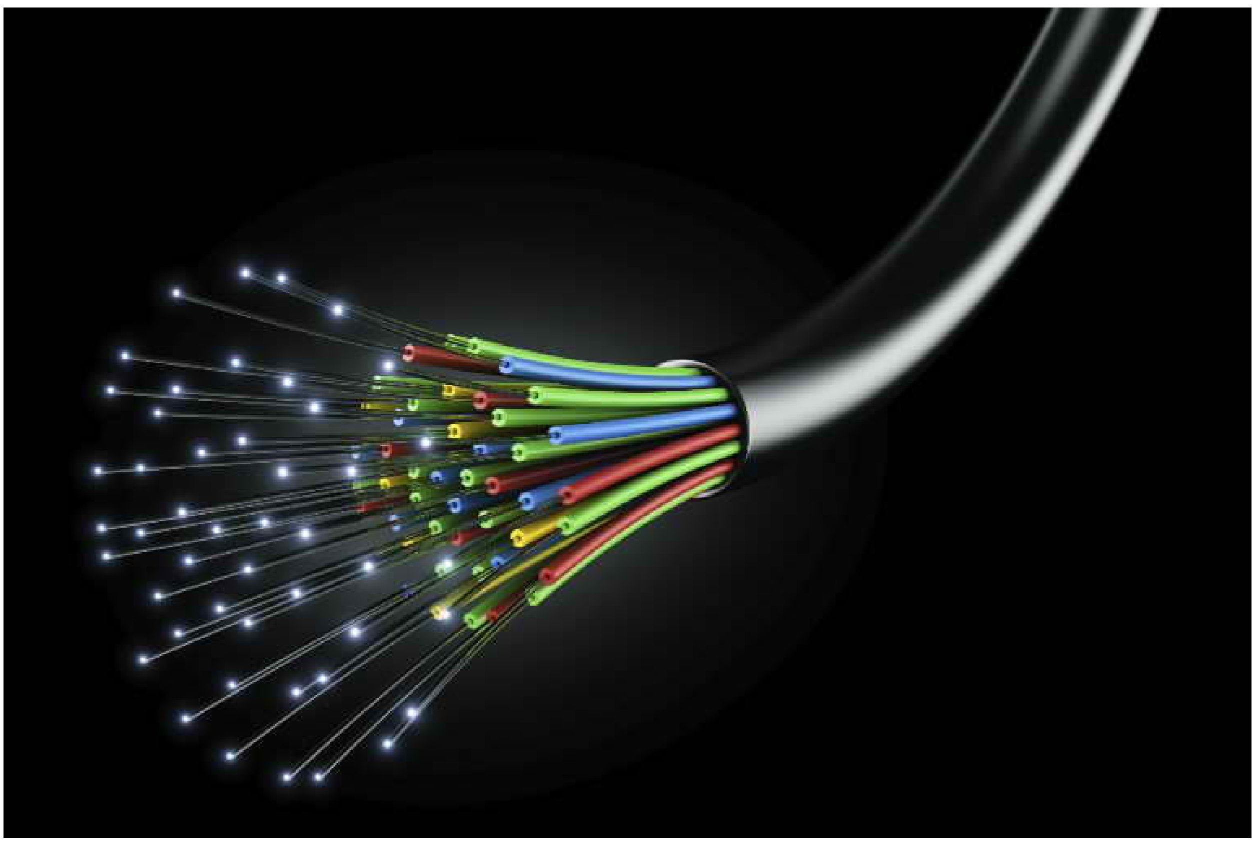
Mascoma Standards	RIST.11.1- Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author	WHST.9.7- Conduct short, as well as more sustained research projects to answer a question, including a self-generated question, or solve a problem; narrow or broaden the

	makes and to any gaps or inconsistencies in the account.	inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
	WHST.11.8- Gather relevant information from multiple print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source, and following a standard format for citation.	WHST.9.9- Draw evidence from informational texts to support analysis, reflection, and research.
	SL.11.5- Make strategic use of digital text (textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of finding, reasoning, and evidence and to add interst.	MP.9.2- Reason abstractly and quantitatively
	MP.9.4- Model with mathematics	HSN.Q. A.9.1- Use units as a way to understand problems and to guide the solution of multi-step problems, choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
	HSN.Q. A.9.2- Define appropriate quantities for the purpose of descriptive modeling.	HSN.Q. A.9.3- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
Vocabulary	Motion of particles, relative position of particles, thermal energy, kinetic energy, field energy, constraints, convert, transfer, closed system, uniform distribution, Second Law of Thermodynamics, interactions, stored energy, stable state,	
Disciplinary Core Ideas	Definitions of Energy • Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. • At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. • These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes	

	radiation, a phenomenon in which energy stored in fields moves across space. Conservation of Energy and Energy Transfer • Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. • Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. • Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (relative positions of charged particles, compression of a spring, etc.) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. • The availability of energy limits what can occur in any system. • Uncontrolled systems always evolve toward more stable states-that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than the surrounding environment cool down). Relationship Between Energy and Forces • When two objects interacting through a field change relative position, the energy stored in the field is changed. Energy in Chemical Processes • Although energy cannot be destroyed, it can be converted to less useful forms- for example, to thermal energy in the surrounding environment. Defining and Delimiting an Engineering Problem • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
Cross-cutting Concepts	Cause and Effect • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. Systems and System Models • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to assumptions and approximations inherent in models. Energy and Matter • Change of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. • Energy cannot be created or destroyed- only moves between one place and another, between objects and fields, or between systems. Influence of Science, Engineering, and Technology on Society and the Natural World • Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

	Scientific Knowledge Assumes an Order and Consistency in Natural Systems • Science assumes the universe is a vast single system in which basic laws are consistent.
Science and Engineering Practice	• Develop and use a model on evidence to illustrate the relationship between systems or between components of a system. • Plan and conduct an investigation, individually and collaboratively, to produce data to serve as the basis for evidence, and in the design; decide on types, amount of data, and accuracy of the data needed to produce reliable measurements and consider limitations on the precision of the data (number of trials, cost, risk, time), and refine the design accordingly. • Create a computational model or simulation of a phenomenon, designed device, process, or system. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.

I Know About Waves and Their Applications in Technologies For Information Transfer



☐ I can use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. (Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth. Assessment is limited t algebraic relationships and qualitative descriptions).

☐ I can evaluate questions about the advantages of using a digital transmission and storage of information (Examples of advantages could include that digital information is relatively stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.).

☐ I can evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other (Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in the light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction and the photoelectric effect. Assessment does not include using quantum theory).

☐ I can evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter (Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias. Assessment is limited to qualitative descriptions).

☐ I can communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy (Examples could include solar cells capturing light and converting it to electricity, medical imaging, and communications technology. Assessment is limited to qualitative information and does not include band theory).

A little primer for my teacher:
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Mascoma Standards	RIST.9.8- Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.	RIST.11.1- Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
	RIST-11.7- Integrate and evaluate multiple sources of information presented in diverse formats and media (quantitative data, video, multi-media) in order to address a question or solve a problem.	RIST-11.8- Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

	WHST.9.2- Write informative/ explanatory tests, including the narration of historical events, scientific procedures/experiments, or technical processes.	WHST.11.8- Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas; avoiding plagiarism and overreliance on any one source, and following a standard format for citation.
	MP-9.2- Reason abstractly and quantitatively.	MP-9.4- Model with mathematics.
	HAS-SSE.A.1- Interpret expressions that represent a quantity in terms of its context.	HAS-SSE.B.3- Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
	HAS-CED.A.4- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	
Vocabulary	Frequency, wave length, speed of waves, mediums, electromagnetic, seismic, radiation, vacuum, digital transmission, digital storage, wave model, particle model, resonance, interference, diffraction, photoelectric, photons, solar cells, medical imaging, digitized, pixels, peaks and troughs, ultraviolet rays, x-rays, gamma rays, ionize, capturing signals	
Disciplinary Core Ideas	Energy in Chemical Processes • Solar cells are human made devices that likewise capture the sun's energy and produce electrical energy. Wave Properties • The wavelength and frequency of a ware are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. • Information can be digitized (e.g. a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances in a series of wave pulses. • Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. Electromagnetic Radiation • Electromagnetic radiation (e.g., radio, microwaves, and light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. • When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy. Shorter wavelength electromagnetic radiation (ultraviolet, x-rays, gamma rays) can ionize atoms and cause damage to living cells.	

	• Photoelectric materials emit electrons when they absorb light of a high-enough frequency. Information Technologies and Instrumentation • Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (medical imaging, communications, scanners, etc.) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.
Cross-cutting Concepts	Cause and Effect • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. • Systems can be designed to cause a desired effect. Systems and System Models • Models (physical, mathematical, and computer) can be used to simulate systems and interactions- including energy, matter, and information flows- within and between systems at different scales. Stability and Change • Systems can be designed for greater or lesser stability. Interdependence of Science, Engineering, and Technology • Science and engineering complement each other in the cycle known as research and development. Influence of Science, Engineering, and Technology on Society and the Natural World • Modern civilization depends on major technological systems. • Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.
Science and Engineering Practice	• Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. • Use mathematical representations of phenomena or design solutions to describe and/or support claims and explanations. • Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying data when possible. • Communicate technical information or ideas (about phenomena and/or the process of development and design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). • A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.