Randolph Township Schools
Randolph Middle School

Grade Eight Science Curriculum

"To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science.""

-Albert Einstein

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EDUCATION EXHIBIT 3 – 8/16/16

Randolph Township Schools
Department of Science, Technology, Engineering, & Mathematics
Grade 8 Science

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Randolph Township Schools

Mission Statement

We commit to inspiring and empowering all students in Randolph schools to reach their full potential as unique, responsible and educated members of a global society.

Randolph Township Schools
Affirmative Action Statement

Equality and Equity in Curriculum

The Randolph Township School district ensures that the district's curriculum and instruction are aligned to the state's standards. The curriculum provides equity in instruction, educational programs and provides all students the opportunity to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, religion, disability or socioeconomic status.

N.J.A.C. 6A:7-1.7(b): Section 504, Rehabilitation Act of 1973; N.J.S.A. 10:5; Title IX, Education Amendments of 1972

RANDOLPH TOWNSHIP BOARD OF EDUCATION
EDUCATIONAL GOALS
VALUES IN EDUCATION

The statements represent the beliefs and values regarding our educational system. Education is the key to self-actualization, which is realized through achievement and self-respect. We believe our entire system must not only represent these values, but also demonstrate them in all that we do as a school system.

We believe:

- The needs of the child come first
- Mutual respect and trust are the cornerstones of a learning community
- The learning community consists of students, educators, parents, administrators, educational support personnel, the community and Board of Education members
- A successful learning community communicates honestly and openly in a non-threatening environment
- Members of our learning community have different needs at different times. There is openness to the challenge of meeting those needs in professional and supportive ways
- Assessment of professionals (i.e., educators, administrators and educational support personnel) is a dynamic process that requires review and revision based on evolving research, practices and experiences
    - Development of desired capabilities comes in stages and is achieved through hard work, reflection and ongoing growth

Randolph Township Schools
Department of Science, Technology, Engineering, & Mathematics
Introduction

Randolph Township Schools is committed to excellence. We believe that all children are entitled to an education that will equip them to become productive citizens of the 21st century. We believe that an education grounded in the fundamental principles of science, technology, engineering, and math (STEM) will provide students with the skills and content necessary to become future leaders and lifelong learners.

A sound STEM education is grounded in the principles of inquiry, rigor, and relevance. Students will be actively engaged in learning as they use real-world STEM skills to construct knowledge. They will have ample opportunities to manipulate materials and solve problems in ways that are developmentally appropriate to their age. They will work in an environment that encourages them to take risks, think critically, build models, observe patterns, and recognize anomalies in those patterns. Students will be encouraged to ask questions, not just the "how" and the "what" of observed phenomena, but also the "why". They will develop the ability, confidence, and motivation to succeed academically and personally.

STEM literacy requires understandings and habits of mind that enable students to make sense of how our world works. As described in Project 2061's *Benchmarks in Science Literacy, The Standards for Technological Literacy,* and *Professional Standards for Teaching Mathematics,* literacy in these subject areas enables people to think critically and independently. Scientifically and technologically literate citizens deal sensibly with problems that involve mathematics, evidence, patterns, logical arguments, uncertainty, and problem-solving.

Grade 8 Science
Introduction

The Grade 8 Science Course is the third and last middle school Science course. We believe that all children are entitled to an education that will equip them to become productive citizens of the 21st century. We believe that an education grounded in the fundamental principles of science inquiry and rigor will provide students with the skills and content necessary to become future leaders. Students would be actively engaged in learning as they model real-world scientific behaviors to construct knowledge. This course introduces key concepts and skills that are essential for students as they prepare for high school science courses. Students will gain an understanding of concepts pertaining to information processing, natural selection, adaptation, evidence of common ancestry, force and motion, introduction to forms of energy, thermal energy, the electromagnetic spectrum, natural resources, and stability and change on Earth. They will have ample opportunities to manipulate materials in ways that are developmentally appropriate to their age. They will work in an environment that encourages them to take risks, think critically, build models, observe patterns, and recognize anomalies in those patterns. Students should be encouraged to ask questions, not just the "how" and the "what" of observed phenomena, but also the "why". Scientific literacy requires understandings and habits of mind that enables students to make sense of how the natural and physical worlds work. As described in Project 2061's *Benchmarks in Science Literacy*, scientific literacy enables people to think critically and independently. Scientifically literate citizens deal sensibly with problems that involve evidence, patterns, logical arguments, and uncertainty. The science curriculum has been developed with age appropriate activities and expectations to achieve these goals.

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Grade 8 Science

SUGGESTED TIME ALLOTMENT	UNIT NUMBER	CONTENT - UNIT OF STUDY
2.5 weeks	**I**	Information Processing
3 weeks	**II**	Natural Selection
4.5 weeks	**III**	Adaptation and Evidence of Common Ancestry
6.5 weeks	**IV**	Force and Motion and Introduction to Forms of Energy
8.5 weeks	**V**	Thermal Energy and The Electromagnetic Spectrum
4 weeks	**VI**	Natural Resources
5 weeks	**VII**	Stability and Change on Earth
2 weeks	**VIII**	Capstone Connections

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Eighth Grade Science
UNIT I: Information Processing

<table>
<tr><th>STANDARDS / GOALS:</th><th>ENDURING UNDERSTANDINGS</th><th>ESSENTIAL QUESTIONS</th></tr>
<tr><td rowspan="8"><u>NGSS:</u>

MS-LS1-8: Gather and synthesize information that sensory receptors responds to stimuli by sending messages to the brain for immediate behavioral storage as memories.

<u>Common Core-Math:</u>

HSN-Q.A.1: Reason quantitatively and use units to solve problems.

HSN-REI.A.1: Understand solving equations as a process of reasoning and explain the reasoning

HSN-REI.B.3: Solve equations and inequalities in one variable.

<u>Common Core- ELA:</u>

RI.8.1-6: Key ideas and details in information text through craft and structure of information text

W.8.4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</td><td>Brain changes can occur in response to the environment and new learning situation.</td><td>• How can I enrich my brain?</td></tr>
<tr><td>Our brains respond strongly to new stimuli and novel information.</td><td>• What makes something memorable? Are memories our most precious possession?</td></tr>
<tr><td>Fossils and artifacts can aid in answering questions about early man.</td><td>• How do we track the progression of early man?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS</td></tr>
<tr><td>Students will know:

We have 100 billion neurons in our brain that will not increase, yet the number of neural connections will.

We are able to build neural pathways in our brain based on the experiences we have.

Sense receptors transmit responses as signals that travel along nerve cells to the brain and are then processed.</td><td>Students will be able to:

Draw a neuron and label its parts.

Explain how neural pathways are created.

Analyze the role of a neuron in the learning process.

Calculate the speed of a neural impulse through the human body.</td></tr>
</table>

	Cause-and-effect relationships may be used to predict response to stimuli in natural systems.	Gather, read, and synthesize information from multiple appropriate sources about sensory receptors' response to stimuli. Assess the credibility, accuracy, and possible bias of each publication and methods used.
	We are able to increase the amount of information we retain by using brain based researched strategies.	Define learning and memory in terms of synapses and connections. Hypothesize why different people remember different items in memory activities. Investigate the properties of human memory and suggest techniques to improve it.
	Our brain is divided into lobes that are responsible for specific functions.	Identify the 6 main parts of the brain. Explain the functions and roles of each area of the brain. List healthy habits that will keep your brain functioning optimally.
	Artifacts and fossils can help us in understanding early man and their brain development. **VOCABULARY:** Neural plasticity, learning, memory, intelligence, artifacts, fossil, evolved, independent, dependent, and controlled variables.	Explain how fossils and artifacts allow us to unravel the mysteries of early man. (Expository Writing)

	KEY TERMS:. Neuron, axon, synapse, Neurotransmitter, dendrite, lobe, Parietal, Occipital, Temporal, Amygdala, Hippocampus, Brain Stem, Cerebellum, stimuli, Neanderthal, impulse, myelination**.**	

ASSESSMENT EVIDENCE: Students will show their learning by:

- Research of primary and secondary resources
- Reflection
- Explanatory writing
- Collaborative discussions
- Inquiry-based lab activities
- Data Analysis

KEY LEARNING EVENTS AND INSTRUCTION:

- Articles on sensory receptors. How do organisms receive and respond to information from their environment? (multiple articles, jigsaw groupings for article review?)
- Articles on Neanderthal tools, Ancient Teeth, Caves and Organization
- Scientific American Article "How Has the Human Brain Evolved?"
- Group inquiry to connect learning to observable phenomena
- Expository Writing Piece: Explain how fossils and artifacts allow us to unravel the mysteries of early man.

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit I: Information Processing

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
2.5 Weeks	**Information Processing**	*Newsela.com- Neanderthal Tools, Teeth, And Caves* *Scientific American Article* *http://faculty.washington.edu/chudler/chmemory.html* *National Geographic Video Clips- Brain Games*

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit II: Natural Selection

<table>
<tr><td rowspan="6">STANDARDS / GOALS:

<u>NGSS:</u>

MS-LS4-4: Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

MS-LS4-5: Gather, read, and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organism.</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>An organism's chance of survival is based on changes to the genetic code.</td><td>• How can change impact an organism's chance of survival?</td></tr>
<tr><td>Natural selection is impacted by environmental factors.</td><td>• How does the environment effect natural selection?</td></tr>
<tr><td>Genetically modified organisms (GMO) have both benefits and detriments to ecosystems.</td><td>• Are genetically modified organisms (GMOs) beneficial or detrimental?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS</td></tr>
<tr><td>Students will know:

Genetic variations of traits in a population increase or decrease some individuals' probability of surviving and reproducing in a specific environment.</td><td>Students will be able to:

Use evidence to argue that variations in the genetic code produce traits that increase an individuals' probability of surviving and reproducing.</td></tr>
</table>

	Natural selection leads to the predominance of certain traits in a population and the suppression of others.	Construct an explanation based on evidence, examples, and data that describes how the process of natural selection creates a predominance or suppression of a specific trait in a population.
	Natural selection may have more than one cause, and some cause-and-effect relationships within natural selection can only be described using probability.	Use probability to describe some cause and effect relationships that can be used to explain why some individuals survive and reproduce in a specific environment.
	Natural selection is one important process through which species change over time in response to changes in environmental conditions.	Support the claim using evidence that environmental conditions impact natural selection.
	The abiotic and biotic features of an ecosystem impact the desirability of specific traits in a community.	Identify key abiotic and biotic features of a specific ecosystem. Correlate a specific feature in the environment to the desirability of a specific trait.
	In artificial selection, humans have the capacity through advances in technology and engineering that can influence certain characteristics of organisms by selection breeding which has thereby created entire new industries.	Investigate and analyze primary documents focused on technologies that have been engineered to assist humans to genetically enhance organisms.
	In artificial selection, humans choose desirable, genetically determined traits to pass on to offspring.	Justify why a specific trait is chosen by humans to genetically modify.
	Artificial selection may have more than one cause, and some cause-and-effect relationships within artificial selection can only be described using probability.	Use probability to describe cause-and-effect relationships within artificial selection.

	VOCABULARY: Population, abiotic, biotic, ecosystem, community, organism, individual, genes, DNA, traits, food chain/web, limiting factor, species, variables, probability, benefits, detriments, suppression, predominance, technologies, claim (noun), desirable, heredity, offspring, reproduction, generation, parental **KEY TERMS:** Natural Selection, genetic variation, Artificial Selection, Selective breeding, Gene Therapy, Genetically Modified Organisms (GMOs)	

ASSESSMENT EVIDENCE: Students will show their learning in various ways, including but not limited to:

- Research of primary and secondary resources
- Reflection
- Explanatory writing
- Collaborative discussions
- Argumentative presentation
- Inquiry-based lab activities
- Data Analysis

KEY LEARNING EVENTS AND INSTRUCTION:

- Article reviews that focus on natural selection, GMOs, artificial selection technologies, and selective breeding.
- Peppered-moth simulation
- Toothpick/cloth inquiry lab

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit II-Natural Selection

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
3 Weeks	**Natural Selection**	*Pearson Interactive Textbook* *pHet Simulations* *Color Variation over Time in Rocket Pocket Mouse Populations:* *http://ngss.nsta.org/Resource.aspx?ResourceID=378* *Catch Up on Tomato Technology:* *http://ngss.nsta.org/Resource.aspx?ResourceID=126* *Peppered-moth Inquiry Lab* *Newsela.com*

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit III: Adaptation and Evidence of Common Ancestry

<table>
<tr><td rowspan="6">STANDARDS / GOALS:

<u>NGSS:</u>

MS-LS4-6: Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

MS-LS4-1: Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

MS-LS4-2: Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

MS-LS4-3: Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>Natural selection and adaptation lead to changes in populations over time.</td><td>• How do populations change over time?</td></tr>
<tr><td>Fossils can provide evidence of an organism’s existence, diversity, extinction, and progression of life forms throughout history.</td><td>• What do fossils tell us about the past?</td></tr>
<tr><td>Analogous structures, homologous structures, and embryology provide evidence of evolutionary relationships between species.</td><td>• How can we infer relationships?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS</td></tr>
<tr><td>Students will know:

Natural selection, which over generations leads to adaptations, is one important process through which species change over time in response to changes in environmental conditions.</td><td>Students will be able to:

Given an important environmental change hypothesize how that feature would drive natural selection and produce adaptations over time.</td></tr>
</table>

	Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common.	Research the population genetics over time associated with a given environmental cause.
	Mathematical representations can be used to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	Use mathematical evidence to support the claim that natural selection leads to the distribution of traits and adaptations.
	The fossil record documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.	Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
	The collection of fossils and their placement in chronological order as identified through the location of sedimentary layers in which they are found is known as the fossil record.	Given location in sedimentary layer infer relative age of fossils.
	Relative fossil dating is achieved by examining the fossil's relative amount of radioactive elements found in the fossil sample.	Estimate the age of fossil based on the relative amount of carbon/uranium/other radioactive element found in sample.
	Patterns exist in the level of complexity of anatomical structures in organisms and correlates to the chronological order of fossil appearance.	Examine fossil samples relating to a similar linage of organism (ie. Whales) and place them in chronological order based on similarities/differences in anatomical structures and other evidence.

	Patterns can occur within one species of organism or across many species.	Examine fossil samples relating to a different linages of various organism (ie. Marine life) and place them in chronological order based on similarities/differences in anatomical structures and other evidence.
	Similarities and differences in the gross anatomical structures among modern organisms and between modern organisms and fossil organisms enable the reconstruction of evolutionary history and the inference of lines of evolutionary decent.	Define analogous and homologous structures. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
	General patterns of relatedness among embryos of different organisms can be inferred by comparing the macroscopic appearance of diagrams or pictures.	Examine embryo images relating to a different linages of various organism (ie. Marine life) and find similarities/differences in anatomical structures evident in various levels of development.
	Similarities in embryological development across multiple species show relationships that are not evident in the fully formed organisms.	Evaluate the credibility, effectiveness, and limitations of using embryos of multiple species to show relationships rather than using fully formed organism samples.
	VOCABULARY: development, similarities, differences, existence, diversity, trait, species, organisms, variations, adapt, anatomy, correlation, structure.	
	KEY TERMS: Evolution, relative dating, radioactive, macroscopic, gross anatomy, fossil layer, sedimentary rock, analogous, homologous, natural selection, index fossil.	

ASSESSMENT EVIDENCE: Students will show their learning in various ways, including but not limited to:

- Reflection
- Explanatory writing
- Collaborative discussions
- Inquiry-based lab activities
- Data Analysis (relative dating in specific)
- Sample analysis/hands-on activities

KEY LEARNING EVENTS AND INSTRUCTION:

- pHet simulations: Radioactive dating
- Exploring environmental effects on population genetics
- Fossil kits-relative dating using anatomical structures and radioactive element amounts
- Examine/compare embryo samples

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit III: Adaptation and Evidence of Common Ancestry

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
4.5 Weeks	**Adaptation and Evidence of Common Ancestry**	*Pearson Interactive Textbook* *pHet Simulations* *Netlogo* *Lab Aids* *Fossil samples/kits* *Embryo images/diagrams* *Newsela.com*

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit IV: Force and Motion/Introduction to Forms of Energy

STANDARDS / GOALS:	**ENDURING UNDERSTANDINGS**	**ESSENTIAL QUESTIONS**
NGSS: **MS-PS2-1:** Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. **MS-PS2-2:** Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. **MS-PS3-1:** Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. **MS-PS3-2:** Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. **MS-PS3-5:** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. **MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful	Newton's laws of motion can be represented mathematically in order to describe how objects react to changes in force and mass, and how objects react to collisions.	• How can force change an object's motion?
	Objects use kinetic energy due to their velocity and mass. Comparatively, objects store potential energy due to their relative distances from a reference point and the objects' masses. Kinetic and potential energies are proportionally related in a defined system and can be represented mathematically using given formulas.	• Why and how do all objects use/store energy?
	When the motion of an object changes energy is transferred from potential energy (stored energy due to position) to kinetic energy (motion energy due to velocity).	• How does energy move between objects?

	KNOWLEDGE	SKILLS
solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **MS-ETS1-2:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **MS-ETS1-3:** Analyze data form tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. **MS-ETS1-4:** Develop a model to generate data for interactive testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	**Students will know:** The change in an object's motion depends on the magnitude and directions of balanced (Newton's first law) and unbalanced forces in a system. The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. Alternatively, a larger force causes a larger change in motion. (Newton's second law) For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). These phenomena can be visualized using models. Kinetic energy may take different forms (e.g., energy in fields, thermal energy, energy of motion). Kinetic energy is related to the mass of an object and separately also related to the speed of an object.	**Students will be able to:** Hypothesize how an object's motion will be impacted given various forces in multiple directions/magnitudes. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. Predict using mathematical evidence how the motion, specifically acceleration, of an object will change given changes in force and mass by apply Newton's second law of motion (Force=mass x acceleration). Apply Newton's Third Law to design a solution, using models, to a problem involving the motion of two colliding objects. Evaluate the effectiveness of this solution using mathematical evidence. Categorize and generate real-world examples of kinetic energy in its many forms (ie. Energy fields, thermal energy, energy of motion). Plan and carry out an investigation that determines the factors impacting the motion of an object.

	Motion energy is properly called kinetic energy; and can be calculated knowing that it is proportional to the mass of the moving object and grows with the square of the object's speed ($KE=0.5mv^2$).	Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
	A system of objects may contain stored (potential) energy, depending on the objects' relative positions.	Categorize and generate real-world examples of potential energy.
	When the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system and can be calculated knowing that it is proportional to the mass of the non-moving object and gravity's force relative to the distance from earth (PE=mgh).	Develop a model, both conceptually and mathematically, to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
	When two objects interact, each one exerts a force on the other that can cause kinetic energy to be transferred to or from the objects.	Conduct an inventory to compare the energies, in terms of speed, present in objects before and after an interaction. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object
	Proportional relationships among different types of quantities provide information about the magnitude of properties and processes.	Evaluate the relationship between changes in types of energies, potential and kinetic, that occur over the motion of an object in a real-world application (i.e. Roller coaster/amusement park rides).
	The more precisely a design task's criteria and constraints can be defined, through the consideration of scientific principles and other relevant knowledge, the more likely it is that the designed solution will be successful.	Design, construct, test, and critique a device that maximizes potential and kinetic energy.

	Models that could include representations, diagrams, pictures, and written descriptions of systems can be used to represent systems and their interactions, such as energy flow within systems. **VOCABULARY:** models, systems, interaction, motion, speed, distance, energy, balanced, unbalanced, force, stored, collision, transfer, problem, brainstorm, design, invention, iteration, modify, test **KEY TERMS:** Newton's laws of motion, inertia, kinetic energy, potential energy, Acceleration, energy transformation, engineering, design process, constraint, innovation, iteration, prototype, troubleshoot, optimize	Assess the scientific principles (energy types, energy relationships, energy transfer) present in the device's model to communicate the scientific stability of their model.

ASSESSMENT EVIDENCE: Students will show their learning in various ways, including but not limited to:

- Reflection
- Explanatory writing
- Collaborative discussions
- Inquiry-based lab activities
- Data Analysis (potential and kinetic energy in specific)
- Design/evaluate engineering solutions
- Applying and creating real-world explanations

KEY LEARNING EVENTS AND INSTRUCTION:

- Large scale demonstrations
- Discrepant event demonstration
- Investigate the motion of collision carts in various setups
- Force diagrams
- Mass car investigations
- Roller Coaster Project- constructing a scaled model of a roller coaster using foam pipe insulation, marbles, masking tape, assess the potential and kinetic energies present in the model (including calculations), critiquing and modifying the model until scientific principles are maximized.
- Roller Coaster simulations

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit IV: Forces and Motion/Introduction to Forms of Energy

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
6.5 Weeks	**Force and Motion/Introduction to Forms of Energy**	*Pearson Interactive Textbook* *pHet Simulations* *Amusement park physics: http://www.learner.org/interactives/parkphysics/* *Potential and Kinetic Energy in Roller Coasters simulations: http://www.pbslearningmedia.org/resource/hew06.sci.phys.maf.rollercoaster/energy-in-a-roller-coaster-ride/* *How Roller Coasters Work: http://science.howstuffworks.com/engineering/structural/roller-coaster3.htm* *Newsela.com*

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit V: Thermal Energy and The Electromagnetic Spectrum

<table>
<tr><td rowspan="8">STANDARDS / GOALS:

<u>NGSS:</u>

MS-PS3-3- Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

MS-PS3-4- Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

MS-PS4-1-Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

MS-PS4-2- Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

MS-PS4-3- Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

MS-ETS1-1: Define the criteria and constraints of a design problem with</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>The thermal energy in a system depends on the type, state, environment and amount of matter present.</td><td>• How can matter influence thermal energy?</td></tr>
<tr><td>Wave properties are influenced by the medium through which it travels and its level of energy.</td><td>• How do waves travel and interact with matter?</td></tr>
<tr><td>Electromagnetic and mechanical waves are used for communication purposes.</td><td>• How can we use wave energy to communicate?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS</td></tr>
<tr><td>Students will know:

Temperature is a measure of the average kinetic energy of particles of matter.

Energy is spontaneously transferred out of hotter regions or objects and into colder ones.</td><td>Students will be able to:

Investigate how adding/removing heat energy affects the temperature and volume of a sample.

Investigate how the temperature of various liquids will influence direction of liquid movement.</td></tr>
</table>

sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **MS-ETS1-2:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **MS-ETS1-3:** Analyze data form tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. **MS-ETS1-4:** Develop a model to generate data for interactive testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	There are relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of particles as measured by the temperature of the sample. The type, state, and amount of matter present, and the environment can be used to influence the amount of thermal energy lost to its environment. A solution needs to be tested and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. A simple wave has repeating patterns with a specific wavelength, frequency, and amplitude.	Individually and collaboratively plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of particles as measured by the temperature of a given sample. Identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. Communicate logical and conceptual connections between gathered evidence and explanations. Apply scientific ideas or principles to design, construct, and test a design of a device that either minimizes or maximizes thermal energy transfer. Test design solutions and modify them on the bases of the test results in order to improve them Use a systematic process for evaluating solutions with respect to how well they meet criteria and constraints. Identify the main parts of a wave.

	Describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	Create a model of transverse and longitudinal waves of various magnitudes. Use mathematical representation to use as evidence to support conclusions of models.
	When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.	Develop and use models to describe the movement of light waves in various materials.
	The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (ex: air vs. water, and air vs. glass)	Develop and use models to describe the path of light waves in various materials.
	A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.	Develop and use models to describe the characteristics of light waves in various materials.
	A sound wave needs a medium through which it is transmitted and this medium can affect the speed at which it travels whereas light waves do not need a medium to travel through.	Develop and use models to compare and contrast the movement of light waves to sound waves in various materials.
	The structure of a wave can be modified to serve particular functions by taking into account properties of different materials and how materials can be shaped and used.	Hypothesis how various materials can have an effect on a wave. Collect data to use as evidence of how different materials can be modified to change the structure of a wave.

	Structures can be designed to use properties of waves to serve particular function. Waves can be used for communication purposes. Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information than are analog signals. Wave-related technologies extend the measurement, exploration modeling, and computational capacity of scientific investigations. **VOCABULARY:** kinetic, transform, conservation, solid, liquid, gas, boiling point, melting point, freezing point, problem, brainstorm, design, invention, iteration, modify, test **KEY TERMS:** Energy transformation, energy conservation, kinetic energy, thermal energy, temperature, specific heat, amplitude, wave speed, amplitude, wavelength, crest, trough, reflection, compression, longitudinal, transverse, mechanical, medium, refraction, absorption, transmitted, analog, digital, electromagnetic spectrum. engineering, design process, constraint, innovation, iteration, prototype, troubleshoot, optimize	Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims that digitized signals are a more reliable way to encode and transmit information than analog signals are.

ASSESSMENT EVIDENCE: Students will show their learning in various ways, including but not limited to:

- Research of primary and secondary resources
- Reflection
- Explanatory writing
- Collaborative discussions
- Inquiry-based lab activities
- Data Analysis
- Design-Evaluate engineering solutions
- Large scale demonstrations
- Discrepant Event Demo

KEY LEARNING EVENTS AND INSTRUCTION:

- pHet simulation (states of matter, gas properties, waves
- Large scale demonstrations
- Discrepant Event Demo
- Lab Discs (collect sound data from various locations)
- Information writing piece

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit V: Thermal Energy and The Electromagnetic Spectrum

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
8.5 weeks	**Thermal Energy and The Electromagnetic Spectrum**	*Pearson Interactive Textbook* *pHet Simulations* *Scientific American articles* *Newsela Articles* *https://spaceflightsystems.grc.nasa.gov/education/rocket/moon.html*

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit VI: Natural Resources

<table>
<tr><td rowspan="6">STANDARDS / GOALS:

<u>NGSS:</u>

MS-ESS3-1: Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
.</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>Resources including minerals, energies, groundwater, and soil are distributed unevenly on Earth due to past and current geoscience processes, as well as removal by humans.</td><td>• Why aren’t all natural resources on earth evenly distributed geographically?</td></tr>
<tr><td>Humans negatively impact the earth by redistributing and/or depleting natural resources in terms of land usage, water usage, pollution, increases in population and per-capita consumption. Alternatively, humans positively impact the earth by designing and engineering solutions to counter and prevent these impacts on Earth’s resources.</td><td>• How do humans influence the abundance of natural resources available on Earth?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS</td></tr>
<tr><td>Students will know:

Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources.</td><td>Students will be able to:

Identify the natural resources available to humans on earth and evaluate the uses that have been developed for these resources.</td></tr>
</table>

	All human activities draw on Earth's land, ocean, atmosphere, and biosphere resources and have both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.	Gather, read, and synthesize information relating to the short-term and long-term effects of using natural resources for human usage. Correlate these findings with positive or negative change over time in the natural environment and health of human populations.
	Minerals, fresh water, and biosphere resources (including but not limited to: petroleum, metal ores, and soil) are distributed unevenly around the planet as a result of past geologic process and can be explained using cause-and-effect relationships.	Identify the location and relative quantity of natural resources (such as petroleum, metal ores, water, and soil) available to humans on earth. Construct an explanation to determine the past geologic processes (such as organic marine sediments, volcanoes, hydrothermal vents, and weathering) the cause of the uneven distribution of these natural resources using evidence.
	Mineral, fresh water, ocean, biosphere, and atmosphere resources are limited and many are non-renewable or replaceable over human lifetimes.	Classify various natural resources as renewable or non-renewable based on the relationship between human consumption rates and organic production rates by the Earth.
	The distribution of some of Earth's land, ocean, atmosphere, and biosphere resources are changing significantly due to removal by humans, and as human populations and per capita consumption increase.	Use data to analyze how the distribution and amount of various natural resources are changing due to removal/consumption by humans.
	Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.	Define and identify relationships as casual or correlational. Provide a real world example of each of type of relationship.

	Changes to Earth's environment can have different impacts (negative and positive) for different livings.	Explain using evidence the type of relationship (causal/correlational) present between an environmental change and the positive/negative impacts on living organisms.
	Changes to Earth's environment due to human activities have significantly altered the availability of natural resources in the biosphere.	Explain using evidence the type of relationship (causal/correlational) present between an environmental change due to human activities and the significant alteration of the availability of a natural resource.
	As humans deplete Earth's non-renewable resources the effects can be negative, such as damaging or destroying natural habitats and causing the extinction of other species.	Review and analyze primary sources relating to the negative events that occur when humans deplete Earth's natural resources. Communicate evidence-based scientific findings to peers that show a relationship (causal or correlational) between the negative events that occur when humans deplete Earth's natural resources.
	Alternatively, as humans deplete Earth's non-renewable resources the effects can be positive, such as the development of new technologies. These technologies alleviate the dependence of humans on Earth's resources, provide alternative energy sources, and reverse/prevent/slow the degradation of the Earth. **VOCABULARY:** abundance, impact, resource, distribution, consumption, usage, positive, negative, relationships, **KEY TERMS:** renewable, non-renewable, causal, correlation, depletion, per-capita, examples referring to specific environmental issues (ex: Fracking)	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment's natural resources and argue for its effectiveness in the real-world.

ASSESSMENT EVIDENCE: Students will show their learning in various ways, including but not limited to:

- Research of primary and secondary resources
- Reflection
- Explanatory writing
- Debate
- Collaborative discussions
- Inquiry-based lab activities
- Data Analysis
- Design-Evaluate engineering solutions

KEY LEARNING EVENTS AND INSTRUCTION:

- Mapping activity to explore the distribution of natural resources on earth
- Causal and correlational relationship investigation
- Investigate the pre-existing technologies that address the depletion of natural resources
- Design, evaluate, and present an engineering solution to an environmental change that relates to the depletion of natural resources by human means.

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit VI: Natural Resources

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
4 weeks	**Natural Resources**	*USGS.gov- natural resource distribution mapping* *Earth Day Network* *Pearson Interactive Textbook* *Newsela.com* *Scientific American* *National Geographic*

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit VII: Stability and Change on Earth

<table>
<tr><td rowspan="6">STANDARDS / GOALS:

<u>NGSS:</u>

MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

.</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>Development of technology allows for humans to predict the occurrence of natural hazards and prepare for these events.</td><td>• How can humans predict and prepare for natural hazards?</td></tr>
<tr><td>Earth’s climate is changing as proven primarily by the rise in global temperatures; in addition, other scientific records of the planet’s qualitative and quantitative characteristics can also provide evidence to support this claim.</td><td>• How is Earth’s climate changing?</td></tr>
<tr><td>Humans can mitigate the effects of the changing climate by developing new technologies that address these concerns.</td><td>• What can humans do to mitigate the effects of the changing climate?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS</td></tr>
<tr><td>Students will know:

Natural hazards can be the result of interior processes, surface processes, or severe weather events.</td><td>Students will be able to:

Associate the natural hazard of volcanoes, earthquakes, severe weather event with the process attributed to their cause.</td></tr>
</table>

	Some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable.	Differentiate natural hazards as predictable and non-predictable. Explain for those natural hazards classified as predictable, the best early-warning systems.
	Mapping the history of natural hazards (data, graphs, charts, images) combined with an understanding of related geologic forces, can help forecast the locations and likelihoods of future events.	Predict and map the location and likelihood of future events using data, graphs, charts, and images.
	Graphs, charts, and images identify and help us to understand patterns of natural hazards in a region in order to help forecast the locations and likelihoods of future events.	Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
	Technology mitigates the effects of natural hazards and vary from region to region and over time.	Investigate the technologies and associated methodology that provides data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
	Stability in Earth's surface temperature might be disturbed either by sudden events or gradual changes that accumulate over time and can have an effect on ecosystems.	Graphically represent data. Use multiple lines of evidence to generate scientific explanations of ecosystem-level changes on the Antarctic Peninsula. Describe ways in which climate change on the Antarctic Peninsula has led to interconnected, ecosystem-level effects. Participate in an interdisciplinary scientific investigation, demonstrating the collaborative nature of science.

	Numerous factors, both human and natural, have caused the rise in global temperatures over the past century.	Identify factors that have contributed to the rise in global temperatures.
	Most notably, the human activity of burning fossil fuels has caused the increased release of greenhouse gases resulting in a rise in global temperatures.	Gather, interpret, and draw conclusions from tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities.
	Studying climate science has provided the knowledge to reduce the level of climate change through the development of various engineering capabilities.	Propose a method that involves a change in human activity to reduce the impacts of climate change.
	VOCABULARY: mitigate, climate, impacts, plate tectonics, atmosphere, phenomena, catastrophic, engineering	
	KEY TERMS: climate change, global warming, greenhouse gases	

ASSESSMENT EVIDENCE: Students will show their learning in various ways, including but not limited to:

- Research of primary and secondary resources
- Reflection
- Explanatory writing
- Collaborative discussions
- Inquiry-based lab activities
- Data Analysis
- Design-Evaluate engineering solutions

KEY LEARNING EVENTS AND INSTRUCTION:

- Interdisciplinary and collaborative scientific investigation focused on the penguin communities shift on the Antarctic Peninsula
- Capstone project in collaboration with Humanities department

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Grade Eight Science
Unit VII: Stability and Change on Earth

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
5 weeks	**Stability and Change on Earth**	*NASA.gov* *NOAA.gov* *Earth Day Network* *Introducing teachers and administrators to the NGSS:* *-Appendix 3: Model Activity Chapter 5: Now you "Sea" Ice, Now You Don't*

APPENDIX A

NGSS http://www.nextgenscience.org/next-generation-science-standards
NJ State Model Curriculum http://www.nj.gov/education/modelcurriculum/sci/ms.shtml