Unit Title: Transfer and Transformation of Energy

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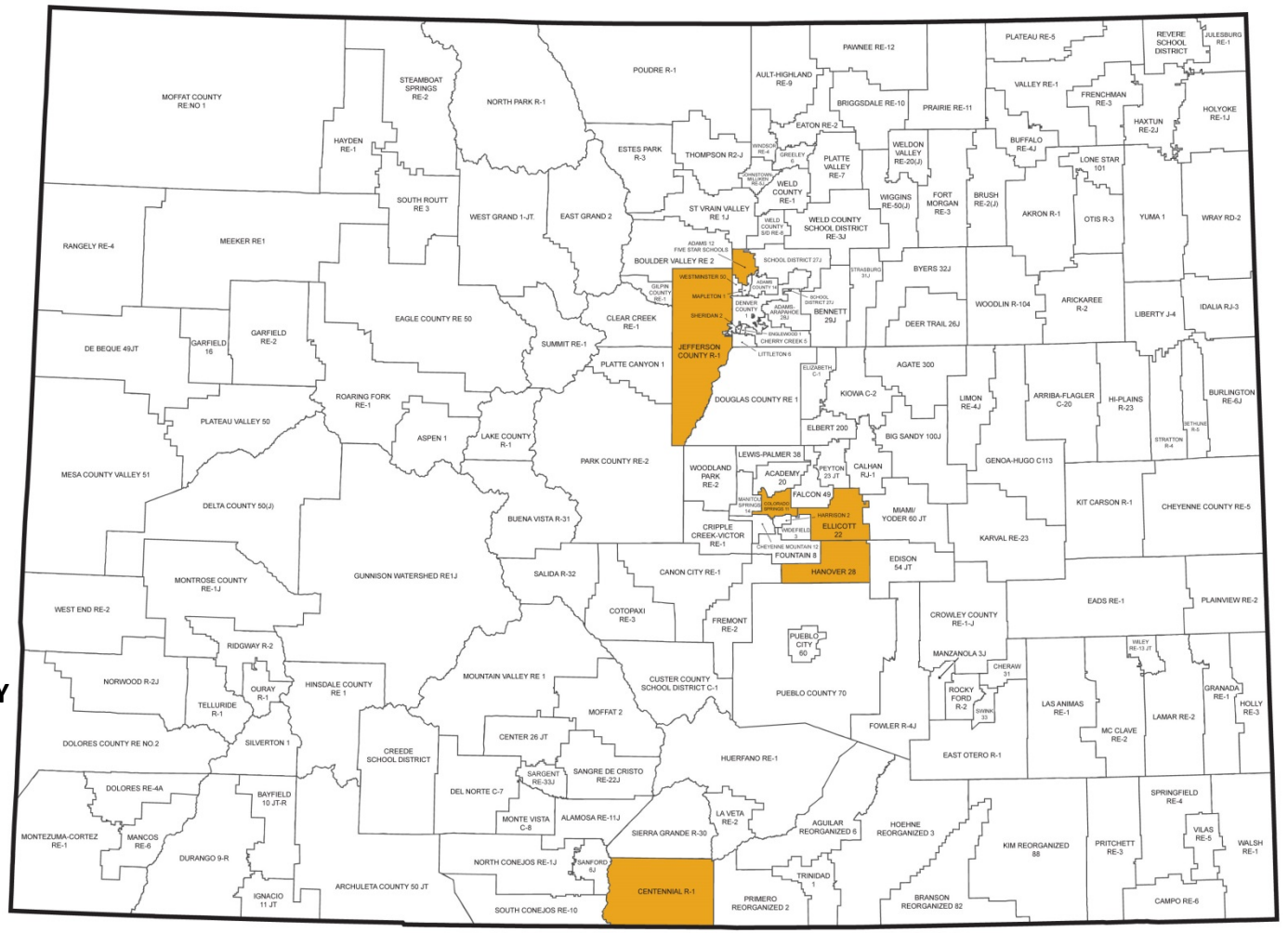

This unit was authored by a team of Colorado educators. The template provided one example of unit design that enabled teacher-authors to organize possible learning experiences, resources, differentiation, and assessments. The unit is intended to support teachers, schools, and districts as they make their own local decisions around the best instructional plans and practices for all students.

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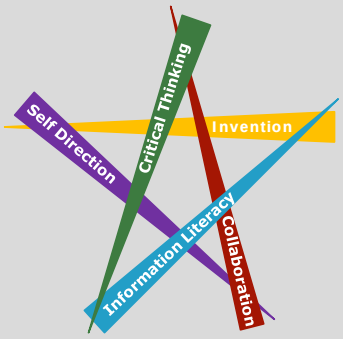
Colorado Teacher-Authored Sample Instructional Unit

Content Area	Science	Grade Level	8th Grade
Course Name/Course Code			

Standard	Grade Level Expectations (GLE)	GLE Code
1. Physical Science	1. Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion	SC09-GR.8-S.1-GLE.1
	2. There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved	SC09-GR.8-S.1-GLE.2
	3. Distinguish between physical and chemical changes, noting that mass is conserved during any change	SC09-GR.8-S.1-GLE.3
	4. Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties	SC09-GR.8-S.1-GLE.4
2. Life Science	1. Human activities can deliberately or inadvertently alter ecosystems and their resiliency	SC09-GR.8-S.2-GLE.1
	2. Organisms reproduce and transmit genetic information (genes) to offspring, which influences individuals' traits in the next generation	SC09-GR.8-S.2-GLE.2
3. Earth Systems Science	1. Weather is a result of complex interactions of Earth's atmosphere, land and water, that are driven by energy from the sun, and can be predicted and described through complex models	SC09-GR.8-S.3-GLE.1
	2. Earth has a variety of climates defined by average temperature, precipitation, humidity, air pressure, and wind that have changed over time in a particular location	SC09-GR.8-S.3-GLE.2
	3. The solar system is comprised of various objects that orbit the Sun and are classified based on their characteristics	SC09-GR.8-S.3-GLE.3
	4. The relative positions and motions of Earth, Moon, and Sun can be used to explain observable effects such as seasons, eclipses, and Moon phases	SC09-GR.8-S.3-GLE.4

Colorado 21st Century Skills



Critical Thinking and Reasoning: *Thinking Deeply, Thinking Differently*

Information Literacy: *Untangling the Web*

Collaboration: *Working Together, Learning Together*

Self-Direction: *Own Your Learning*

Invention: *Creating Solutions*

Reading & Writing Standards for Literacy in Science and Technical Subjects 6 - 12

Reading Standards

- Key Ideas & Details
- Craft And Structure
- Integration of Knowledge and Ideas
- Range of Reading and Levels of Text Complexity

Writing Standards

- Text Types & Purposes
- Production and Distribution of Writing
- Research to Construct and Present Knowledge
- Range of Writing

Unit Titles	Length of Unit/Contact Hours	Unit Number/Sequence
Transfer and Transformation of Energy	7-9 weeks	3

Unit Title	Transfer and Transformation of Energy		**Length of Unit**	7-9 weeks
Focusing Lens(es)	Relationships	**Standards and Grade Level Expectations Addressed in this Unit**	SC09-GR.8-S.1-GLE.2 SC09-GR.8-S.1-GLE.4 SC09-GR.8-S.2-GLE.1 SC09-GR.8-S.3-GLE.1	
Inquiry Questions (Engaging-Debatable):	• How would global climate change affect the weather? • How would life be different if energy could not transform? • How are waves harmful or helpful to society? • How would weather be different if heat did not move in predictable patterns?			
Unit Strands	Physical Science, Life Science			
Concepts	Energy, Conservation, Waves, Change, Transformation, Variation, Ecosystems, Patterns, Weather, Interactions, Resources			

Generalizations **My students will Understand that…**	**Guiding Questions** **Factual**	**Conceptual**
Predictable patterns of energy allow humans to transform and harness it for personal use (SC09-GR.8-S.1-GLE.2-EO.a; RA.3,4)	What are different ways that living things obtain and use energy? (SC09-GR.8-S.1-GLE.2-EO.a) What are the different forms of energy that humans use? (SC09-GR.8-S.1-GLE.2-EO.a) What are the properties of light? (SC09-GR.8-S.1-GLE.4-EO.d; RA.4)	Is there a limit to how many times energy can be transferred? (SC09-GR.8-S.1-GLE.2; IQ.3) In order to preserve global ecosystems, should humans have a limited energy budget? (SC09-GR.8-S.2-GLE.1-EO.a,b; IQ.1; RA.1)
Energy from waves transforms into useable resources which allows organisms to gather information from environmental surroundings (SC09-GR.8-S.1-GLE.2; RA.1) and (SC09-GR.8-S.1-GLE.4; RA.5)	What forms of energy travel as waves? (SC09-GR.8-S.1-GLE.4; RA.3; N.1) What are the different types of waves? (SC09-GR.8-S.1-GLE.4-EO.a; IQ.1) How can waves be described (i.e. amplitude, frequency, wavelength, and speed)? (SC09-GR.8-S.1-GLE.4-EO.b; RA.2)	How are light and sound waves similar and different? (SC09-GR.8-S.1-GLE.4-EO.c; RA.1,2) How are pitch and frequency related in sound? (SC09-GR.8-S.1-GLE.4-EO.c; RA.1,2)
Human energy production and consumption choices can directly and indirectly change societies and ecosystems, impacting life as we know it (SC09-GR.8-S.2-GLE.1-EO.a,b,d; IQ.1; RA.1)	What are examples of renewable or non-renewable energy sources? (SC09-GR.8-S.1-GLE.2-EO.a)	What factors should be considered when making energy production and consumption choices? (SC09-GR.8-S.1-GLE.2-EO.a) and (SC09-GR.8-S.2-GLE.1-EO.a,b,d; IQ.1; RA.1)
Weather patterns result from complex interactions of matter and energy in the atmosphere (SC09-GR.8-S.3-	How do scientists measure and describe weather? (SC09-GR.8-S.3-GLE.1-EO.c; RA.1, N.1)	Why does weather vary from day to day? (SC09-GR.8-S.3-GLE.1; IQ.1)

GLE.1)	What factors define weather? (SC09-GR.8-S.3-GLE.1-EO.a; IQ.3) What are some safety concerns associated with severe weather? (SC09-GR.8-S.3-GLE.1-EO.a; IQ.3; RA.3; N.2)	What are the strengths and limitations of different types of weather models? (SC09-GR.8-S.3-GLE.1; IQ.2) How is weather predicted? (SC09-GR.8-S.3-GLE.1-EO.b, IQ.2,3; RA.2,3)

Critical Content: **My students will Know…**	**Key Skills:** **My students will be able to (Do)…**
• Different forms of energy and how they can be transferred from one form to another, while total energy is conserved. (SC09-GR.8-S.1-GLE.2-EO.a,b,c) • Different types of waves that can be described through amplitude, frequency, wavelength, and speed. (SC09-GR.8-S.1-GLE.4-EO.a,b) • Why and how heat moves from hotter to colder areas through convection, conduction, and radiation. • The relationship between pitch and frequency in sound. (SC09-GR.8-S.1-GLE.4-EO.c) • The properties of light: absorption, reflection, and refraction (SC09-GR.8-S.1-GLE.4-EO.d) • Human activities that use energy to alter and impact ecosystems (SC09-GR.8-S.2-GLE.1-EO.a,b,c,d,e) • Factors that define weather: precipitation, humidity, air pressure and temperature • Safety concerns associated with severe weather (SC09-GR.8-S.3-GLE.1-EO.a) • Models of interacting variables used to predict weather (SC09-GR.8-S.3-GLE.1-EO.c; RA.2)	• Gather, analyze and interpret data and develop an analysis describing forms of energy and energy transfer. (SC09-GR.8-S.1-GLE.2-EO.a,b) • Use research-based models to describe energy transfer and predict amounts of energy transferred (SC09-GR.8-S.1-GLE.2-EO.c) • Compare and contrast different types of waves through describing changing properties (SC09-GR.8-S.1-GLE.4-EO.a,b,c) • Develop and design a scientific investigation regarding absorption, reflection, and refraction of light (SC09-GR.8-S.1-GLE.4-EO.d) • Develop, communicate, and justify an evidence-based explanation through analysis and interpretation of data from a variety of resources, while recognizing and inferring potential bias, focusing on of how human use of energy may alter ecosystems (SC09-GR.8-S.2-GLE.1-EO.a,b,c,d,e) • Observe and gather data for various weather conditions and compare to historical data for that date and location (SC09-GR.8-S.3-GLE.1-EO.b) • Differentiate between basic and severe weather condition (SC09-GR.8-S.3-GLE.1-EO.a) • Evaluate and use models to develop and communicate a weather prediction. (SC09-GR.8-S.3-GLE.1-EO.c; N.1)

Critical Language: includes the Academic and Technical vocabulary, semantics, and discourse which are particular to and necessary for accessing a given discipline.
EXAMPLE: A student in Language Arts can demonstrate the ability to apply and comprehend critical language through the following statement: *"Mark Twain exposes the hypocrisy of slavery through the use of satire."*

A student in _____ can demonstrate the ability to apply and comprehend critical language through the following statement(s):	*Energy exists in various forms and is conserved as it is transformed.* *Different types of waves share characteristics and also have unique properties.* *Various forms of energy production and consumption can deliberately or inadvertently impact biotic and abiotic environments.* *Weather happens because of interactions of energy and matter in the atmosphere, which can be described through models.*

Academic Vocabulary:	Mechanisms, predict, analyze, interpret, transformation, investigation, compare, contrast, properties, alter, impact, issue, interpret, justify, evidence, bias, design, critique, models, inquiry
Technical Vocabulary:	Potential energy (gravitational, nuclear, chemical, mechanical) kinetic energy (mechanical, chemical, radiant, nuclear, thermal, electrical, sound) waves, medium, conservation, renewable, nonrenewable, heat, conduction, convection, radiation, electromagnetic, pitch, frequency, amplitude, frequency, pitch, absorption, reflection, refraction, precipitation, atmosphere, front, humidity, wind, pressure, tornado, hurricane, tsunami, buoy, satellites, radar, forecast

Unit Description:	This unit focuses on how energy is transformed and transferred across different systems. The types and nature of energy will be investigated as they relate to weather and weather patterns, available resources, and features found in energy waves. This unit culminates in a performance assessment that has students critically examining human activity with regard to harnessing energy.
Considerations:	A new generalization was created for this unit to better capture the overarching conceptual ideas presented within the unit. This generalization is the key generalization. This unit may be taught at the same time as the 8th grade Social Studies unit on human/environmental interactions. Misconceptions: • Human activity does not impact the Earth's systems. • Energy can be created. • "Energy" and "force" are interchangeable. • Light passes through transparent objects without changing direction. • Ultrasounds are extremely loud sounds. • Light can only be reflected from shiny surfaces. • Energy can be changed completely from one form to another (no energy loss). • Ultraviolet energy only comes from the Sun. • Filters change the color of light • All radiation is harmful • renewable energy always works and is cheaper • Visible light is the only type of light
Unit Generalizations	
Key Generalization:	Energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measureable, which interact within a complex system.
Supporting Generalizations:	Energy from waves allows organisms to gather information from environmental surroundings.
	Weather patterns result from complex interactions of matter and energy in the atmosphere
	Human energy production and consumption choices can directly and indirectly change societies and ecosystems,impacting life as we know it

Performance Assessment: *The capstone/summative assessment for this unit.*	
Claims: (Key generalization(s) to be mastered and demonstrated through the capstone assessment.)	Energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable, which interact within a complex system.
Stimulus Material: (Engaging scenario that includes role, audience, goal/outcome and explicitly connects the key generalization)	You are an American Congressman asked to write a persuasive essay to the World Health Organization regarding carbon emissions and their effects on the global environment. Select a position to argue about carbon emissions (whether or not carbon emissions are damaging, beneficial, or non-partisan to the environmental well-being). Your argument must explain how energy consumption and availability are linked to the production of carbon emissions, how the transfer of energy is or is not affecting the environment, and how viable/effective forms of non-carbon emitting energies could be.
Product/Evidence: (Expected product from students)	Students will take the role of a congressman writing a persuasive essay to the World Health Organization. They will choose a position (for or against) regarding carbon emissions and global environmental effects. They must include: • direct change to the ecosystem • connect at least one component of the electromagnetic spectrum • Interactions for sustainability through energy consumption http://www.time4writing.com/writing-resources/writing-resourcespersuasive-essay/ (tips on writing a persuasive essay)
Differentiation: (Multiple modes for student expression)	The teacher may allow students to verbally debate the topic.

Texts for independent reading or for class read aloud to support the content	
Informational/Non-Fiction	**Fiction**
Science Lab: The Transfer of Energy -Zuchora-Walske, C. [lexile level 740] *Transfer of Energy - de Pinna, S. [lexile level 1110]* *Forms of Energy - Claybourne, E. [lexile level 900]* *Changing Energy Forms - Duggan, L. [lexile level 840]* *Ocean, Tidal, and Wave Energy: Power from the Sea* -Pepas, L. [lexile level 1090] *Renewable Energy* - Chapman, S. [lexile level 850] *Thinking Critically: Renewable Energy* - Allen, J. [lexile level 1320] *Science Lab: Weather Patterns* - Hand, C. [lexile level 830] *Hazy Skies: Weather and the Environment* - Kahl, J. [lexile level 1020]	*Dancing Waves* - Singer, Z. [lexile level 620] *20,000 Leagues Under the Sea* - Verne, J. [lexile level 1030]

Ongoing Discipline-Specific Learning Experiences				
1.	Description:	Communicating like a Scientist: Reading and writing critically	Teacher Resources:	http://www.phschool.com/eteach/language_arts/2002_12/essay.html (Strategies to help develop reading comprehension skills) http://www.readingrockets.org/article/3479/ (7 tips with resources to help students' reading comprehension)
			Student Resources:	http://www.brainpop.com/english/studyandreadingskills/readingskills/ (Reading comprehension movie and quiz)

				http://www.brainpop.com/english/writing/mainidea/ (Main idea movie and quiz) http://www.brainpop.com/math/dataanalysis/graphs/preview.weml (Analyzing graphs movie and quiz)
	Skills:	Identify bias Be a critical consumer of information Investigate and determine key pieces of information Communicate and justify a scientific position	Assessment:	Students will be assessed within the learning experiences.
2.	Description:	Thinking like a Scientist: Identify Patterns	Teacher Resources:	http://projectsharetexas.org/resource/analyzing-data-identify-patterns-predict-trends-formulate-reasonable-explanations-and (Project share website with information around identifying patterns in science)
			Student Resources:	http://www.sis.pitt.edu/~spring/patterns/node11.html (Information for students around identifying patterns in science)
	Skills:	Analyze and conceptualize patterns of energy and patterns within a complex system	Assessment:	
3.	Description:	Working like a Scientist: Using the Scientific method	Teacher Resources:	http://www.brainpopjr.com/science/scienceskills/scientificmethod/grownups.weml (Near middle of page teacher resources page with activities) http://undsci.berkeley.edu/teaching/misconceptions.php (A list of common misconceptions about the nature of science) http://undsci.berkeley.edu/teaching/ (Tips for introducing and teaching scientific method and experimentation) http://www.livescience.com/6727-invisible-gorilla-test-shows-notice.html (Video in which most people fail to observe large "gorilla" moving across room) http://www.shodor.org/succeed-1.0/forensic/teacher/lessons/observation.html (Lesson plan devoted to developing observation skills) http://blogs.loc.gov/teachers/2011/06/look-again-challenging-students-to-develop-close-observation-skills/ (Library of Congress brief of tools for helping students develop observation skills) http://static.nsta.org/files/ss1506_25.pdf (The Who, What, When, and Where of Waves)
			Student Resources:	http://www.brainpopjr.com/science/scienceskills/scientificmethod/grownups.weml (At top of page student link for movie and activities about scientific method) http://www.glencoe.com/sites/common_assets/science/virtual_labs/E16/E16.html (Virtual lab to practice use of scientific method and experimentation) http://www.brainpop.com/science/scientificinquiry/scientificmethod/preview.weml (Movie and quiz for scientific method/inquiry)

				http://lifehacker.com/5960811/how-to-develop-sherlock-holmes+like-powers-of-observation-and-deduction (Explanation of tools to increase observation skills with hook related to Sherlock Holmes)
	Skills:	Developing and designing an investigation	Assessment:	Students will be assessed within the learning experiences.

Prior Knowledge and Experiences

Students must have a basic understanding of solving for variables within a formula, and types of energy.

Vertical Articulation: Students have last seen concepts related to this unit in 6th, 5th, 4th, and 2nd grades.

Learning Experiences # 1 – 4
Instructional Timeframe: Weeks 1-5

Learning Experience # 1

The teacher may provide graphic organizers and examples of energy transformations so students can demonstrate how energy is transformed and conserved.

Generalization Connection(s):	Energy from waves allows organisms to gather information from environmental surroundings. Predictable patterns of energy allow humans to transform and harness it for personal use.
Teacher Resources:	http://www.graphic.org/goindex.html (multiple graphic organizers) http://schools.hsd.k12.or.us/Portals/99/Staff%20Folders/Homework/Potential%20and%20Kinetic%20Energy.pdf (powerpoint on potential and kinetic energy) http://tinyurl.com/prrlxaj (Entire website provides teacher background knowledge and student activities) http://www.hotwheels.com/en-us/speedometry.html (free kit for teachers http://web.stanford.edu/group/lpchscience/cgi-bin/wordpress/images/Potential-and-Kinetic-Energy-T.pdf (roller coaster lab) https://www.youtube.com/watch?v=c6PQ49B5Gpw (Includes many options for Hot Wheels videos)
Student Resources:	http://www.glencoe.com/sites/common_assets/science/virtual_labs/E04/E04.html (Virtual Energy Transformation Lab) http://discoverykids.com/games/build-a-coaster/ (Build Your Own Coaster) http://www.hotwheels.com/en-us/videos/THW-trailer.html (scroll for multiple videos) http://www.learner.org/interactives/parkphysics/coaster/ (Amusement Park Physics) https://www.youtube.com/watch?v=c6PQ49B5Gpw (video for real world Hot Wheels)

Assessment:	Students will apply their knowledge of potential and kinetic energy through the design of a lab (e.g., a Hot Wheels lab, power plant simulation). http://www.hotwheels.com/en-us/content/images/speedometry/Speedometry_Grade_4_Lessons.pdf	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	
	The teacher may provide a graphic organizer The teacher may provide a word bank	The student may match terms to images
Extensions for depth and complexity:	**Access** (Resources and/or Process)	
	The teacher may provide an alternative resource to build a roller coaster	The student may design a roller coaster using on-line resources
Critical Content:	• potential energy • kinetic energy • thermal energy • electrical energy • gravitation • nuclear • chemical • mechanical • radiant • sound • conservation	
Key Skills:	• Predicting the amount of energy transferred	
Critical Language:	Gravitational, nuclear, chemical, mechanical, radiant, sound, conservation, potential, kinetic, thermal, electrical energy	

Learning Experience # 2	
The teacher may utilize various resources (digital, video, simulations) demonstrating the organization of the electromagnetic spectrum so that students can comprehend how the electromagnetic spectrum transfers information to organisms.	
Generalization Connection(s):	Energy from waves allows organisms to gather information from environmental surroundings.
Teacher Resources:	http://www.discoveryeducation.com/teachers/free-lesson-plans/the-electromagnetic-spectrum-waves-of-energy.cfm (lessons plans) http://science.hq.nasa.gov/kids/imagers//ems/index.html (website on electromagnetic spectrum with links amounting to a tour through the spectrum) http://sciencedonewright.weebly.com/uploads/1/9/0/8/19082697/spectrum_coloring_.pdf (spectrum coloring diagram)

	http://www.ck12.org/book/CK-12-Physical-Science-For-Middle-School/r1/section/20.3/ (Lessons with videos and illustrations) http://www.ck12.org/book/CK-12-Physical-Science-For-Middle-School/r1/section/20.1/ (Intro lesson on wave energy) http://www.pbs.org/wgbh/nova/physics/electromagnetic-spectrum.html (Electromagnetic Spectrum Tour) http://konawaenahs.k12.hi.us/Online%20Electromagnetic%20Spectrum%20Activity.pdf (Electromagnetic Spectrum Activity)	
Student Resources:	http://sciencedonewright.weebly.com/uploads/1/9/0/8/19082697/spectrum_coloring_.pdf (spectrum coloring diagram) http://www.ck12.org/book/CK-12-Physical-Science-For-Middle-School/r1/section/20.3/ (Lessons with videos and illustrations) http://www.ck12.org/book/CK-12-Physical-Science-For-Middle-School/r1/section/20.1/ (Intro lesson on wave energy) http://www.pbs.org/wgbh/nova/physics/electromagnetic-spectrum.html (Electromagnetic Spectrum Tour) http://missionscience.nasa.gov/ems/emsVideo_01intro.html (video tour on the electromagnetic spectrum)	
Assessment:	The student will label sections of the electromagnetic spectrum, from gamma rays to radio. Additionally, the student will describe the uses of each type of energy on the spectrum.	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide a word bank. The teacher may allow the students to work in groups.	The student may verbally present their understanding of the electromagnetic spectrum.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	N/A	The student may create and label a digital diagram of the electromagnetic spectrum.
Critical Content:	• Electromagnetic spectrum, waves, gamma ray, xray, infrared, ultraviolet, wavelength	
Key Skills:	• Label a diagram of the electromagnetic spectrum • Correlate each category within the electromagnetic spectrum with a use.	
Critical Language:	Electromagnetic spectrum, waves, label, diagram, gamma rays, ultraviolet, infrared, wavelength, correlate	

Learning Experience # 3	
The teacher will differentiate and illustrate the properties of waves so that students can analyze and predict changes that would occur with changes to a wave's features.	
Generalization Connection(s):	Energy from waves allows organisms to gather information from environmental surroundings.
Teacher Resources:	http://www.ck12.org/book/CK-12-Physical-Science-For-Middle-School/r1/section/20.2/ (Lessons on properties of waves) http://ww w.ck12.org/book/CK-12-Physical-Science-For-Middle-School/section/19.2/ (Lessons with videos on measuring waves) http://www.physicsclassroom.com/class/waves/Lesson-2/The-Anatomy-of-a-Wave (parts of a wave and wave behavior) https://phet.colorado.edu/en/simulation/wave-on-a-string (interactive tutorial about parts of waves) http://missionscience.nasa.gov/ems/01_intro.html (Introduction to the Electromagnetic Spectrum interactive) http://www.pbslearningmedia.org/resource/lsps07.sci.phys.energy.wavelength/wavelength/ (wavelength lab)
Student Resources:	http://www.ck12.org/book/CK-12-Physical-Science-For-Middle-School/r1/section/20.2/ (Lessons on properties of waves)

	http://www.ck12.org/book/CK-12-Physical-Science-For-Middle-School/section/19.2/ (Lessons with videos on measuring waves) http://www.bbc.co.uk/schools/gcsebitesize/science/aqa/waves/generalwavesact.shtml (interactive tutorial on waves and wave activity) http://missionscience.nasa.gov/ems/01_intro.html (Introduction to the Electromagnetic Spectrum interactive) http://clarkscience8.weebly.com/electromagnetic-spectrum-8-68.html (Interactive)	
Assessment:	Students will predict/calculate the resulting change in wave properties based on given changes to other properties.	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide a vocabulary glossary of key terms. The teacher may allow the use of calculators. The teachers may allow students to work in partners or small groups.	The student may select the possible effects from a list of options
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teachers may allow students to work in partners or small groups.	The student may demonstrate and explain different wave properties using musical instruments or other wave-producing items.
Critical Content:	● Wave ● Wavelength ● Pitch ● Frequency ● Amplitude ● Crest ● Trough ● Hertz ● Speed ● Longitudinal ● Transverse	
Key Skills:	● Calculate quantities using given formulas ● Explain the relationship between different properties.	
Critical Language:	Wave, wavelength, pitch, frequency, amplitude, crest, trough, Hertz, speed, electromagnetic spectrum, sound, light	

Learning Experience # 4	
The teacher may utilize a variety of resources (digital, video, simulations) demonstrating reflection, refraction, and absorption so that students can analyze the effects on waves passing through a medium or surface.	
Generalization Connection(s):	Energy from waves allows organisms to gather information from environmental surroundings.
Teacher Resources:	http://www.ck12.org/book/CK-12-Physical-Science-For-Middle-School/r1/section/19.3/ (sound wave lessons and videos) http://k12.phys.virginia.edu/Labs/Lab05.pdf (Labs and activities)

<table>
<tr><td></td><td colspan="2">http://sciencediscovery.colorado.edu/wp-content/uploads/2012/08/PFF-Light.pdf (unit on light including activities)
http://www.kaleidoscopesusa.com/about/how-kaleidoscopes-work/ (brief article on how kaleidoscopes work)
http://www.pbslearningmedia.org/resource/lsps07.sci.phys.energy.wavelength/wavelength/ (wavelength lab)</td></tr>
<tr><td>Student Resources:</td><td colspan="2">http://www.ck12.org/book/CK-12-Physical-Science-For-Middle-School/r1/section/19.3/ (sound wave lessons and videos)
http://www.physicsclassroom.com/Physics-Interactives/Refraction-and-Lenses/Refraction/Refraction-Interactive (refraction interactive)
http://www.pbslearningmedia.org/resource/lsps07.sci.phys.energy.refractdemo/refraction-of-light-demonstration/ (refraction of light demonstration)
http://education.nationalgeographic.com/media/visible-light/ (visible light video)</td></tr>
<tr><td>Assessment:</td><td colspan="2">Students will develop and design an investigation for absorption, reflection, and refraction of light
http://www.physicsclassroom.com/Physics-Interactives/Refraction-and-Lenses/Refraction/Refraction-Interactive (refraction interactive)

Student should create a hypothesis about how 3 different mediums will affect the reflection/refraction of light</td></tr>
<tr><td rowspan="2">Differentiation:
(Multiple means for students to access content and multiple modes for student to express understanding.)</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>The teacher may provide a glossary of terms
The teacher may reduce the assignment
The teacher may allow the students to work in groups</td><td>N/A</td></tr>
<tr><td rowspan="2">Extensions for depth and complexity:</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>The teacher may allow students to design a kaleidoscope.
The teacher may allow students to work in pairs to research and experiment echolocation and infrasound.</td><td>The student may explain how to design and make a kaleidoscope making sure to discuss the reflection and refraction of light.</td></tr>
<tr><td>Critical Content:</td><td colspan="2">● Absorption
● Reflection
● Refraction
● Medium
● Compression
● Pressure
● Doppler Effect
● Rarefaction
● Translucent
● Opaque,
● Transparent</td></tr>
<tr><td>Key Skills:</td><td colspan="2">● Identify the different types of waves
● Develop and design a scientific investigation referencing absorption, reflection, and refraction
● Differentiate amongst absorption reflection and refraction</td></tr>
</table>

Critical Language:	Absorption, reflection, refraction, medium, compression, pressure, Doppler Effect, rarefaction, translucent, opaque, transparent

Learning Experiences # 5 – 7
Instructional Timeframe: Weeks 6-7

Learning Experience # 5

The teacher may utilize video clips, media reports, and articles about energy sources so students can evaluate different forms of energy and determine sustainability and efficiency of those resources.

Generalization Connection(s):	Predictable patterns of energy allow humans to transform and harness it for personal use Human energy production and consumption choices can directly and indirectly change societies and ecosystems,impacting life as we know it	
Teacher Resources:	http://www.greentechmedia.com/articles/category/green-building (multiple articles for sustainability and efficiency) http://www.mdpi.com/2071-1050/7/2/2086 (Article for sustainability of water) http://www.theguardian.com/sustainability/sustainability-report-2014-operations (GNM sustainibilty report) http://www.somerset.k12.wi.us/faculty/eolson/altenergywebquest.cfm (alternative energy webquest) http://www.world-nuclear.org/info/Energy-and-Environment/Sustainable-Energy/ (renewable energy with consideration to nuclear) http://www.pepsico.com/docs/album/sustainability-reporting/pep_2013_sustainability_report.pdf (Pepsi and sustainibility) http://lbre.stanford.edu/sem/Water_Efficiency (water efficiency video) http://energy.gov/articles/video-supertruck-barreling-down-road-sustainability (Video for green trucks) http://science360.gov/obj/video/69cb22d0-be8c-48ef-b851-6064142eddc8/green-revolution-green-roofs Video for green roofs) http://www.nrel.gov/docs/gen/fy01/30927.pdf (renewable energy activities) http://www.pbs.org/wgbh/nova/labs/educators/energy-guide/ (energy lab collection)	
Student Resources:	http://www.mysusthouse.org/game.html (UK game about sustainability choices) https://youtu.be/fHztd6k5ZXY (TED-Ed video regarding a global look at energy)	
Assessment:	Students will complete a graphic organizer to compare and contrast two forms of energy and write a paragraph stating which form of energy would be the most efficient for personal use. Each student will then identify whether or not the form of energy chosen is sustainable in 10 years & 100 years.	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide a partially completed graphic organizer. The teacher may provide an outline for the paragraph.	The student may communicate the required information visually or verbally.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	N/A	The student may create a persuasive piece (essay, Power Point, speech) advocating for a chosen form of energy and its advantages over alternative forms of energy.

Critical Content:	• Renewable • Non-renewable • Conversion • Sustainability • Energy • Solar energy • Water energy • Geothermal energy • Nuclear energy • Biomass energy • Fossil fuels • Oil • Natural gas • Coal • Nuclear
Key Skills:	• Differentiate between renewable and non-renewable resources • Identify renewable energy sources • Identify non renewable energy sources
Critical Language:	Renewable, non-renewable, conversion, energy, sustainability, solar energy, wind energy, water energy, geothermal energy, nuclear energy, biomass energy, fossil fuels, oil, natural gas, coal, nuclear

Learning Experience # 6	
The teacher may illustrate and explain the layers of atmosphere so that students can differentiate between the layers and relate how their properties may affect the interaction of energy movement.	
Generalization Connection(s):	Weather patterns result from complex interactions of matter and energy in the atmosphere
Teacher Resources:	http://ds9.ssl.berkeley.edu/LWS_GEMS/3/layers.htm (layers of the atmosphere) http://www.srh.noaa.gov/jetstream/atmos/layers.htm (layers of the atmosphere) http://earthguide.ucsd.edu/earthguide/diagrams/atmosphere/ (interactive demonstration of the layers of the atmosphere and details about each layer (temperature, elevation, etc.) http://teachertech.rice.edu/Participants/louviere/atmos.html (atmosphere history, composition, labs, etc,.)
Student Resources:	https://eo.ucar.edu/basics/wx_1_b.html (basic descriptions of the layers of the atmosphere) http://www.windows2universe.org/earth/Atmosphere/layers.html (overview with links to the individual layers) http://calipsooutreach.hamptonu.edu/atmosphere.swf (tutorial about objects found in different layers) http://calipsooutreach.hamptonu.edu/arcade.html (Atmospheric Arcade) http://tinyurl.com/d9ga5wq (Layers of the Atmosphere with multiple resources) http://www.sepuplhs.org/middle/iaes/students/simulations/sepup_atmosphere.html (Layers interactive) http://earthguide.ucsd.edu/earthguide/diagrams/atmosphere/ (layers interactive)

Assessment:	The students will create a diagram or model of Earth's atmosphere and explain how some of the features and properties of each layer relate to the transfer of energy around the planet.	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide fill-in-the-blank notes. The teacher may preview/review the vocabulary.	The student may complete their explanation using a graphic organizer.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may explore comparisons between Earth's atmosphere and other planets' atmospheres.	The student may create a model predicting the likely result of changing the properties of certain layers in the atmosphere.
Critical Content:	• atmosphere • troposphere • stratosphere • mesosphere • thermosphere • ionosphere	
Key Skills:	• Diagram and/or model features of the Earth • Explain cause and effect relationships	
Critical Language:	Atmosphere, troposphere, stratosphere, mesosphere, thermosphere, ionosphere, pressure, radiation	

Learning Experience # 7	
The teacher may model weather systems and dramatize interactions of the earth and atmosphere and their impact on humans so the student can summarize how multiple systems combine to create weather patterns.	
Generalization Connection(s):	Weather patterns result from complex interactions of matter and energy in the atmosphere
Teacher Resources:	http://www.education.noaa.gov/Weather_and_Atmosphere/Weather_Systems_and_Patterns.html (NOAA details about weather systems) http://www.phschool.com/atschool/phsciexp/active_art/weather_fronts/ (weather front demonstrations of air masses) http://geology.com/teacher/weather.shtml (collection of meteorological websites, data, and history) http://learnmoreaboutclimate.colorado.edu/science-standards (Climate Change Resources))
Student Resources:	http://www.dd.ucar.edu/ (hurricane landfall game) http://cimss.ssec.wisc.edu/wxfest/hurricane/hurr.html (Interactive hurricane simulation) http://www.scholastic.com/kids/weather/ (basic daily weather simulation) http://teacher.scholastic.com/activities/wwatch/index.htm (entire interactive weather website, including videos)
Assessment:	The student will research one of the following historical weather events and identify the interactions that allowed the transformation

	of energy which produced the event. The student will create a presentation (poster, Prezi, PowerPoint)) describing and modeling the contributing atmospheric conditions, i.e. cold front, high oceanic water temperatures, as well as the human and environmental impacts of the event. • Hurricane Katrina • 2004 Indian Ocean Tsunami • Mount St. Helens Eruption	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow the students to work in groups. The teacher may provide specific websites for research.	The student may write an essay about the research and diagram the weather through an illustration.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	N/A	Students may act out a dramatization.
Critical Content:	• Precipitation • Hurricane • Tornado • Tsunami • Cyclone • Anti-cyclone • Front • Stationary • Occluded • Forecast	
Key Skills:	• Differentiate between basic and severe weather. • Research a historical event	
Critical Language:	differentiate, research, precipitation, hurricane, tornado, tsunami, cyclone, anti-cyclone, front, stationary, occluded, forecast	

Learning Experiences # 8 - 9
Instructional Timeframe: Weeks 9-10

Learning Experience # 8	
The teacher may describe the methods in which heat is transferred so that students can identify and explain examples of heat transfer in their environment.	
Generalization Connection(s):	Weather patterns result from complex interactions of matter and energy in the atmosphere

	Energy from waves allows organisms to gather information from environmental surroundings.	
Teacher Resources:	http://www.physicsclassroom.com/class/thermalP/Lesson-1/Methods-of-Heat-Transfer (explanations of heat transfer) http://coolcosmos.ipac.caltech.edu/cosmic_classroom/light_lessons/thermal/transfer.html (explanations of heat transfer) http://www.efunda.com/formulae/heat_transfer/home/overview.cfm (overview of heat transfer with links to more in-depth details about each type)	
Student Resources:	https://www.wisc-online.com/learn/natural-science/earth-science/sce304/heat-transfer-conduction-convection-radiation (tutorial on heat transfer) http://apollo.lsc.vsc.edu/classes/met130/notes/chapter2/htrans_intro.html (tutorial and quiz on heat transfer) http://www.edinformatics.com/math_science/how_is_heat_transferred.htm (explanation of heat transfer with an explanation of "heat")	
Assessment:	Students will complete a graphic organizer to describe the types of heat transfer and provide and justify examples of heat transfer from the environment.	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may preview/review vocabulary The teacher may provide a modified graphic organizer	The student may categorize/label examples of heat transfer.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may explain the use of insulators.	The student may calculate the efficiency of each time of heat transfer. The student may design a structure to reduce the amount of heat lost in different types of heat transfer.
Critical Content:	• convection • conduction • radiation	
Key Skills:	• Justify the use of a transfer of heat as an example of convection, conduction, or radiation. • Diagram a transfer of heat	
Critical Language:	Conduction, convection, radiation, heat, (thermal) energy, density, justify	

Learning Experience # 9	
The teacher may provide opportunities for students to explore global wind and oceanic patterns so that students can predict the likely changes to weather conditions.	
Generalization Connection(s):	Weather patterns result from complex interactions of matter and energy in the atmosphere
Teacher Resources:	http://ww2010.atmos.uiuc.edu/(Gh)/wwhlpr/hurricane_globalwinds.rxml (wind belts of the general circulation)

	http://www.ces.fau.edu/nasa/content/resources/global-wind-patterns.php (description of global wind patterns) http://www.independent.co.uk/life-style/gadgets-and-tech/interactive-watch-the-worlds-winds-swirl-across-the-globe-in-real-time-9010475.html (article describing the interactive global map) http://earth.nullschool.net/ (interactive global map showing near real-time data of oceanic and wind patterns - data updated every 3 hours) http://www.weather.gov (US National Weather Service) http://www.noaa.gov/ (National Oceanic and Atmospheric Administration)	
Student Resources:	http://earth.nullschool.net/ (interactive global map showing near real-time data of oceanic and wind patterns - data updated every 3 hours) http://www.edheads.org/activities/weather/ (weather-predicting interactive tutorial) http://www.ussartf.org/predicting_weather.htm (reference information for predicting weather)	
Assessment:	Students will predict and justify the effects of changes in the weather when given data regarding oceanic and wind pattern observations.	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may preview/review vocabulary The teacher may provide modified notes/diagrams	The student may express their predictions verbally. The student may predict a reduced number of changes.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to work in partners or small groups. The teacher may allow students to research atmospheric and climate information from other planets in the solar system.	The student may generate multiple viable outcomes for oceanic and wind pattern observations.
Critical Content:	• El Niño • La Niña • Oceanic currents • Wind currents • Buoy	
Key Skills:	• Predict likely weather changes using models	
Critical Language:	El Niño, La Niña, oceanic currents, wind currents, ocean, atmosphere, pattern, buoy	

Learning Experience #10
The teacher may engage in a discussion about the utilization of atmospheric measurement methods and provide weather data

opportunities so that students can make predictions about the environment around them.		
Generalization Connection(s):	Weather patterns result from complex interactions of matter and energy in the atmosphere	
Teacher Resources:	http://ww2010.atmos.uiuc.edu/%28Gh%29/guides/mtr/fcst/home.rxml (how forecasts are made) http://www.education.noaa.gov/Special_Topics/Data_Resources/#page=All (historical weather data collections) http://www.ncdc.noaa.gov/cdo-web/ (searchable historical weather database)	
Student Resources:	http://tinyurl.com/pjp2xk6 (lesson with review questions) http://tinyurl.com/obdrrgb (climate vs. weather review game) https://www.youtube.com/watch?v=RTkPlhc3k-0 (video about weather data collection tools) https://www.youtube.com/watch?v=tzLQC_29RYA (video about weather data collection tools) http://www.ncdc.noaa.gov/cdo-web/ (searchable historical weather database)	
Assessment:	The student will observe and gather and/or analyze data on weather conditions and compare them to historical norms for the location. They will evaluate their measurements and make a general long range forecast for the following weeks.	
Differentiation: (Multiple means for students to access content and multiple modes for student to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow the students to work in groups. The teacher may provide partial observed data. The teacher may provide historical norms.	N/A
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide students with the tools to record the data directly themselves.	N/A
Critical Content:	Radar, temperature, heat, wind, anemometer, humidity, pressure, barometer, satellites, weather vane, hygrometer	
Key Skills:	• Observe and record data over several weeks • Distinguish between weather and climate	
Critical Language:	Observe, distinguish, radar, temperature, heat, wind, anemometer, humidity, pressure, barometer, satellites, weather vane, hygrometer	

Learning Experience # 11	
The teacher may facilitate a Socratic Seminar focusing on environmental conservation so that students can analyze negative and positive human impacts on a local and/or global scale.	
Generalization Connection(s):	Human energy production and consumption choices can directly and indirectly change societies and ecosystems, impacting life as we know it. Predictable patterns of energy allow humans to transform and harness it for personal use.

<table>
<tr><td>Teacher Resources:</td><td colspan="2">http://www.paideia.org/about-paideia/socratic-seminar/ (How to Teach a Socratic Seminar)
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4322762/ (Socratic Seminar in Science Class)
http://www.wikihow.com/Write-a-Persuasive-Essay (tutorial)</td></tr>
<tr><td>Student Resources:</td><td colspan="2">N/A</td></tr>
<tr><td>Assessment:</td><td colspan="2">Students will participate in a Socratic Seminar and complete a handout on their perspective
http://tinyurl.com/nmyfq64 (hand-out for seminar)</td></tr>
<tr><td rowspan="2">Differentiation:
(Multiple means for students to access content and multiple modes for student to express understanding.)</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>The teacher may utilize the buddy system.</td><td>The student may confer with a partner to enhance participation.</td></tr>
<tr><td rowspan="2">Extensions for depth and complexity:</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>The teacher may provide students with an opposing question to counter an opinion.</td><td>The student may give an opposing argument to his/her belief</td></tr>
<tr><td>Critical Content:</td><td colspan="2">• Sustainability
• Limited resources
• Natural resources
• Geographic areas/availability
• Stewardship
• Climate change
• Global warming
• Employment opportunity
• Mining
• Health impact
• Fracking</td></tr>
<tr><td>Key Skills:</td><td colspan="2">• Identify potential bias through articles as human activities use energy which may alter ecosystems.
• Evaluate an energy source based on its potential impacts to humans and ecosystems.
• Identify varying perspectives as humans use energy which may alter ecosystems.</td></tr>
<tr><td>Critical Language:</td><td colspan="2">Alter, impact, bias, perspective, critique sustainability, limited resources, natural resources, geographic areas/availability, stewardship, climate change, global warming, employment opportunity, mining, health impact, fracking</td></tr>
</table>