Unit Title: Energy Transformations in Living Things

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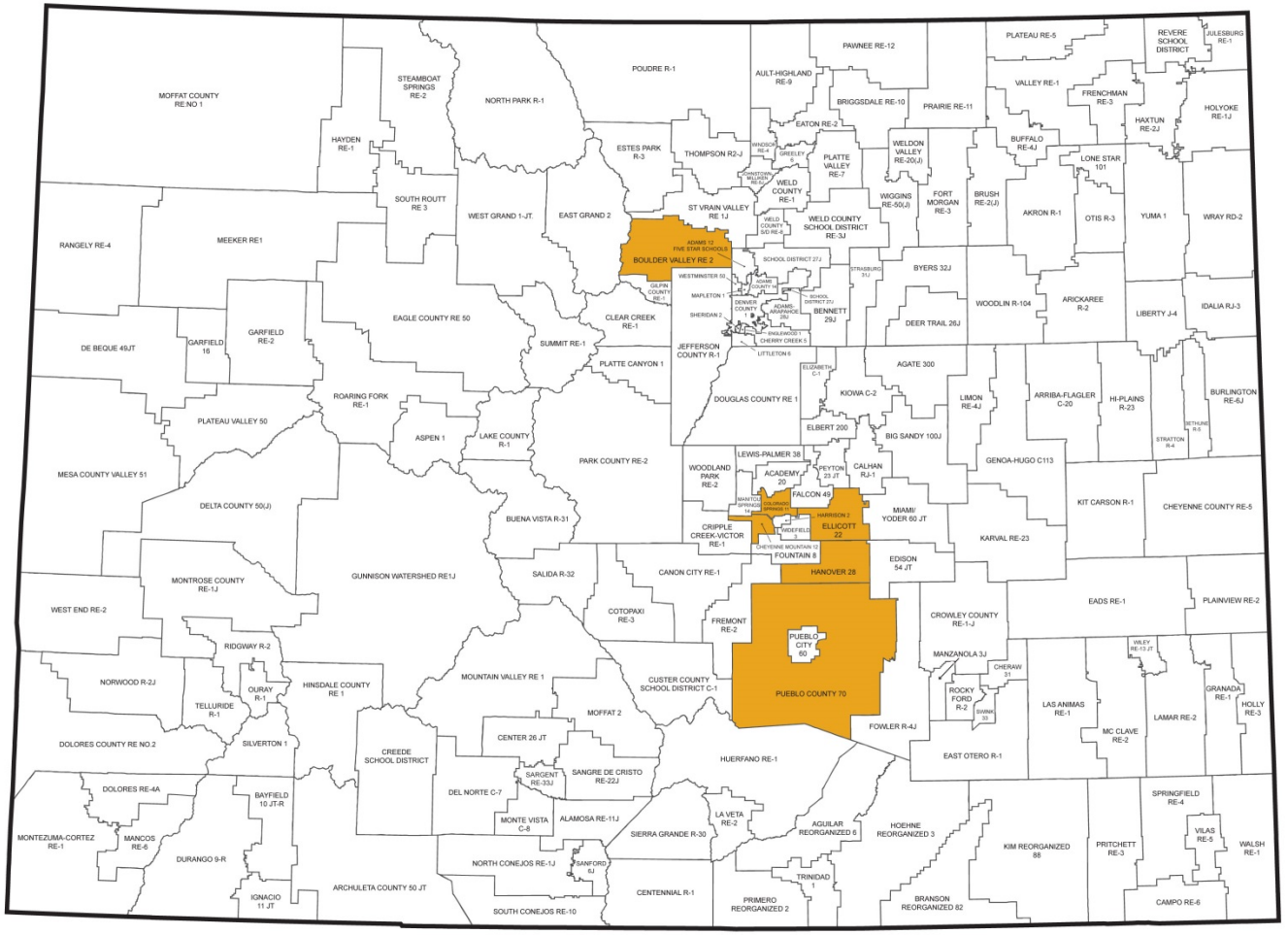

This unit was authored by a team of Colorado educators. The template provided one example of unit design that enabled teacher-authors to organize possible learning experiences, resources, differentiation, and assessments. The unit is intended to support teachers, schools, and districts as they make their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

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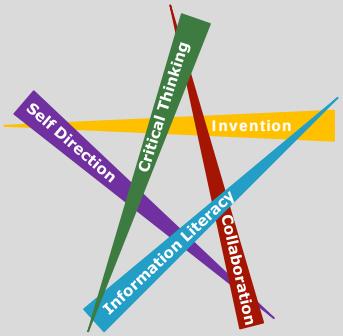
Colorado Teacher-Authored Sample Instructional Unit

Content Area	Science	Grade Level	7th Grade
Course Name/Course Code			

Standard	Grade Level Expectations (GLE)	GLE Code
1. Physical Science	1. Mixtures of substances can be separated based on their properties such as solubility, boiling points, magnetic properties, and densities	SC09-GR.7-S.1-GLE.1
2. Life Science	1. Individual organisms with certain traits are more likely than others to survive and have offspring in a specific environment	SC09-GR.7-S.2-GLE.1
	2. The human body is composed of atoms, molecules, cells, tissues, organs, and organ systems that have specific functions and interactions	SC09-GR.7-S.2-GLE.2
	3. Cells are the smallest unit of life that can function independently and perform all the necessary functions of life	SC09-GR.7-S.2-GLE.3
	4. Photosynthesis and cellular respiration are important processes by which energy is acquired and utilized by organisms	SC09-GR.7-S.2-GLE.4
	5. Multiple lines of evidence show the evolution of organisms over geologic time	SC09-GR.7-S.2-GLE.5
3. Earth Systems Science	1. Major geologic events such as earthquakes, volcanic eruptions, mid-ocean ridges, and mountain formation are associated with plate boundaries and attributed to plate motions	SC09-GR.7-S.3-GLE.1
	2. Geologic time, history, and changing life forms are indicated by fossils and successive sedimentation, folding, faulting, and uplifting of layers of sedimentary rock	SC09-GR.7-S.3-GLE.2

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
Energy Transformations in Living Things	2-4 weeks	2

Unit Title	Energy Transformations in Living Things		**Length of Unit**	2-4 weeks
Focusing Lens(es)	Transformation	**Standards and Grade Level Expectations Addressed in this Unit**	SC.09-GR.7-S.2-GLE.4	
Inquiry Questions (Engaging-Debatable):	• What might be the effect of increased carbon dioxide in the air on plant and animal life? • What would happen to life as we know it is there was no sunlight and energy transformation?			
Unit Strands	Life Science			
Concepts	Energy, transformation, photosynthesis, respiration, process			

Generalizations **My students will Understand that…**	**Guiding Questions** **Factual**	**Conceptual**
Photosynthesis and cellular respiration are both chemical processes that support life through the transformation of light energy into a form of energy that is usable by organisms (SC.09-GR.7-S.2-GLE.4-EO.a,b; IQ.2; RA.2)	What are the basic reactants and products of photosynthesis and cellular respiration? (SC.09-GR.7-S.2-GLE.4-EO.a) What is the relationship between photosynthesis and cellular respiration? (SC.09-GR.7-S.2-GLE.4-EO.b) What energy transformations occur in both the processes of photosynthesis and cellular respiration? (SC.09-GR.7-S.2-GLE.4-EO.b; IQ.2)	How does life depend upon photosynthesis? (SC.09-GR.7-S.2-GLE.4-EO.a) Why do humans need oxygen in order to live? (SC.09-GR.7-S.2-GLE.4-EO.a) From where does a plant get most of the matter that makes up its mass? (SC.09-GR.7-S.2-GLE.4-EO.a) Why do living organisms need energy? (SC.09-GR.7-S.2-GLE.4; RA.2)
The process of photosynthesis uses organelles specific to plants to transform and store energy (SC.09-GR.7-S.2-GLE.4-EO.b; IQ.2)	How do plants transform energy?	What might the consequences be for life on Earth, if the amount of radiation from the Sun reaching the Earth's surface was significantly less than it is now – for example, if ash from a massive volcanic eruption filled the upper layers of the atmosphere? (SC.09-GR.7-S.2-GLE.4-EO.b; RA.1, 3)
Cellular respiration transforms and uses energy differently from photosynthesis (SC.09-GR.7-S.2-GLE.4-EO.b; IQ.2)	How do animal cells transform energy?	How are photosynthesis and cellular respiration the same and different? (SC.09-GR.7-S.2-GLE.4-EO.a; IQ.2)

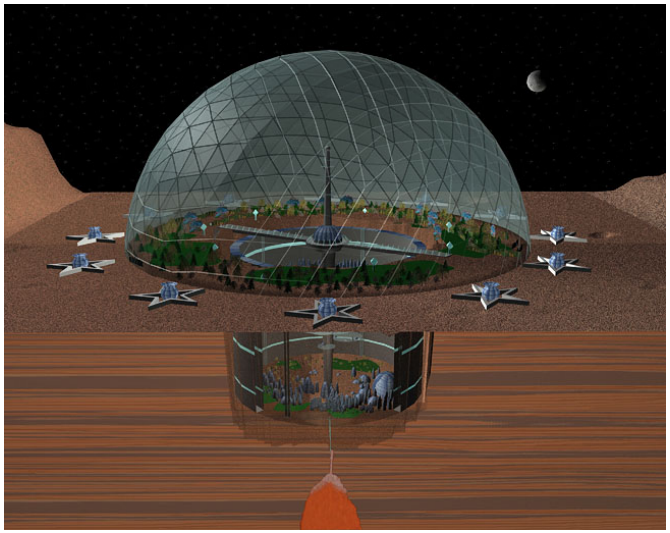
Critical Content: **My students will Know…**	**Key Skills:** **My students will be able to (Do)…**
• The common process of cellular respiration in both plants and animals, and the unique (plant) process of photosynthesis (SC.09-GR.7-S.2-GLE.4) • The inputs (reactants) of photosynthesis: light energy, carbon dioxide and water (SC.09-GR.7-S.2-GLE.4-EO.a) • The outputs (products) of photosynthesis: sugar (glucose) and oxygen (SC.09-GR.7-S.2-GLE.4-EO.a) • The inputs (reactants) of cellular respiration: sugar (glucose) and oxygen (SC.09-GR.7-S.2-GLE.4-EO.a) • The outputs (products) of cellular respiration: energy, carbon dioxide and water (SC.09-GR.7-S.2-GLE.4-EO.a) • The reasons why plants are essential for human health and the health and survival of Earth's ecosystems (SC.09-GR.7-S.2-GLE.4;RA.1) • How energy in the form of food comes from Sunlight via photosynthesis (SC.09-GR.7-S.2-GLE.4; RA.2) • How fossil fuels result from the photosynthesis of organisms that lived millions of years ago (SC.09-GR.7-S.2-GLE.4; RA.3)	• Gather, analyze, and interpret data regarding the basic functions of photosynthesis and cellular respiration (SC.09-GR.7-S.2-GLE.4-EO.1) • Use direct and indirect evidence to describe the relationship between photosynthesis and cellular respiration within plants – and between plants and animals (SC.09-GR.7-S.2-GLE.4-EO.2) • Use computer simulations to model the relationship between photosynthesis and cellular respiration within plants – and between plants and animals (SC.09-GR.7-S.2-GLE.4-EO.3) • Ask a testable question and make a falsifiable hypothesis about photosynthesis or respiration and design an inquiry-based method to find an answer (SC.09-GR.7-S.2-GLE.4;N.1) • Design an experiment to observe photosynthesis or respiration, and clearly define controls and variables (SC.09-GR.7-S.2-GLE.4;N.2) • Share experimental data, and respectfully discuss conflicting results emulating the practice of scientists (SC.09-GR.7-S.2-GLE.4; N.3)

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):	*The products of photosynthesis (sugar and oxygen) are also the reactants of cellular respiration.*
Academic Vocabulary:	Inputs, outputs, process, energy, transformation, testable question, hypothesis, control, variable, food
Technical Vocabulary:	Photosynthesis, cellular respiration, products, reactants, oxygen, carbon dioxide, sugar, glucose, light

Unit Description:	This unit focuses on energy transfer between photosynthesis and cellular respiration. It begins with a review of cellular organelles (vacuole, mitochondria, cell membrane, cell wall, chloroplasts, etc.). It then progresses into photosynthesis (using the chemical equation), cellular respiration, and their interconnectedness within the environment. The unit culminates in a performance assessment that asks students to create a formal presentation to NASA executives who are thinking about colonizing Mars.
Considerations:	**Consideration:** Cell theory and structure and function of cells need to be taught prior to this unit. This unit requires lab supplies and access to the internet. For districts on a four day work week, this unit may take between 3-4 weeks instead of the suggested 2-3 weeks. Teachers can consider teaching this unit through the context of the carbon cycle. **Possible misconceptions:** Plants do not use cellular respiration Plants breathe Respiration and breathing are the same thing Oxygen and "air" mean the same thing Plants and fungi are the same Unicellular is the same as prokaryotic Bacteria do not use photosynthesis, but use cellular respiration Bacteria have mitochondria and chloroplasts The smallest form of matter is a cell Atoms, molecules and organelles are alive Photosynthesis "creates" energy
Unit Generalizations	
Key Generalization:	Photosynthesis and cellular respiration are both chemical processes that support life through the transformation of light energy into a form of energy that is usable by organisms.
Supporting Generalizations:	The process of photosynthesis uses organelles specific to plants to transform and store energy.
	Cellular respiration transforms and uses energy differently from photosynthesis.

Performance Assessment: *The capstone/summative assessment for this unit.*	
Claims: (Key generalization(s) to be mastered and demonstrated through the capstone assessment.)	Photosynthesis and cellular respiration are both chemical processes that support life through the transformation of light energy into a form of energy that is usable by organisms.
Stimulus Material: (Engaging scenario that includes role, audience, goal/outcome and explicitly connects the key generalization)	You are a scientist tasked to create a formal presentation (Power Point, Prezi, Voicethread, etc.) to NASA executives who are thinking about colonizing Mars. You are asked to discuss the necessary resources for this mission. NASA will supply an empty "biodome" (see image below) that the colony will use to support life. Your presentation needs to include:

	• All ingredients (non-living things) necessary for photosynthesis or cellular respiration to occur • Explanations of how each ingredient is necessary for photosynthesis or cellular respiration • Four organisms (living things) and how they each get their energy to survive • An explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms  Example of a biodome (http://www.nss.org/settlement/calendar/biodomecity.htm)  Image for reference: sun, earth, and mars
Product/Evidence: (Expected product from students)	Students will take the role of a scientist tasked to create a formal presentation (Power Point, Prezi, Voicethread, etc.) to NASA executives who are thinking about colonizing Mars. They need to discuss the necessary resources for this mission. NASA will supply an empty "biodome" that the colony will use to support life. Their presentation needs to include: • All ingredients (Oxygen, Carbon Dioxide, water, ATP, glucose, and sunlight) necessary for photosynthesis or cellular respiration to occur • Explanations of how each chosen ingredient is necessary for photosynthesis or cellular respiration

	• Four organisms (living things) and how they each get their energy to survive • An explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms *Students should not have access to outside sources. This assessment is intended to be done within the class period.
Differentiation: (Multiple modes for student expression)	• The teacher may change the number of ingredients and organisms to suit student population. • The teacher may use a cloze method to assist in the presentation • The teacher may allow for an illustrated product in lieu of the written form • The teacher may limit or extend the presentation medium (video, poster, etc.) • The teacher may alter the required criteria to accomplish the same outcome To extend this work, the teacher may allow students to think about constraints on the ingredients and consider how this would affect the organisms introduced to the "biodome."

Texts for independent reading or for class read aloud to support the content

Informational/Non-Fiction	Fiction
Photosynthesis: Changing Sunlight into Food – Bobbi Kalman [lexile level 710] *Animal Cells and Life Processes* – Barbara Sumervill [lexile level 860] *The Carbon Cycle* – Charlie Duke [lexile level 560]	*Straight from the Bear's Mouth: The Story of Photosynthesis* – Bill Ross [lexile level 1000]

Ongoing Discipline-Specific Learning Experiences

1.	Description:	Thinking 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)

			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:	Designing an experiment, identifying variables, and analyzing results.	Assessment:	The students will be assessed within the learning experiences
2.	Description:	Working like a scientist: Using graphing and mathematics skills	Teacher Resources:	Power Point presentation (Dealing with identification of dependent and independent variables) http://professionaldevelopment.ibo.org/files/ocd/TaughtPractice%20with%20%20identifying%20variables.pdf (Practice worksheet for identifying dependent and independent variables) http://www.clemson.edu/ces/phoenix/tutorials/graph/index.html (Rules for graphing) http://www.wtamu.edu/academic/anns/mps/math/mathlab/beg_algebra/beg_alg_tut9_bar.htm#line3 (Teaches how and why to use different graphs and also teaches how to read a graph) http://www.teachervision.fen.com/skill-builder/graphs-and-charts/48946.html?page=1&detoured=1 (Provides questions to ask students as they analyze a graph) http://nces.ed.gov/nceskids/createagraph/default.aspx (Online way to create different types of graphs)
			Student Resources:	http://nces.ed.gov/nceskids/createagraph/default.aspx (Online way to create different types of graphs)
	Skills:	Creating and interpreting graphs, creating data tables, creating and interpreting models.	Assessment:	Students may create graphs using data from learning experiences in order to analyze relationships between variables. Teachers may make real-time observations and provide feedback for students on their ability to set up a graph correctly.

Prior Knowledge and Experiences
Students must have an understanding of structure and function of cells, graphing skills, lab skills, basic understanding of energy, basic understanding of chemical equations, access to technology, understanding of scientific method, and the difference between living and nonliving. **Vertical Articulation:** The last time students have seen the concepts within this unit was in 5th, 3rd, and 2nd grades.

Learning Experience # 1
Instructional Timeframe: Weeks 1

Learning Experience # 1		
The teacher may provide various opportunities (games, matching, review activities, etc.) for recall of cell structure and function so that students can activate prior knowledge in preparation for application and transfer to photosynthesis and cellular respiration.		
Generalization Connection(s):	The process of photosynthesis uses organelles specific to plants to transform and store energy. Cellular respiration transforms and uses energy differently from photosynthesis.	
Teacher Resources:	http://mrkaloudis.weebly.com/resources.html (Cell review stations) http://quizlet.com/7864096/ch7-cell-structure-and-function-review-flash-cards/ (Quizlet for cell structure and function) http://mrkaloudis.weebly.com/resources.html (Cell organelles)	
Student Resources:	http://www.cellsalive.com/ (Animations of cells and functions) https://play.google.com/store/apps/details?id=org.hudsonalpha.icell&hl=en (icell app for iPad) http://www.phschool.com/science/biology_place/biocoach/cells/quiz.html (Cell structure and function quiz)	
Assessment:	Students will label a cell diagram and describe the organelles function. http://www.google.com/search?q=cells+alive&oq=cells+alive&aqs=chrome..69i57j0l5.2472j0j4&sourceid=chrome&es_sm=93&ie=UTF-8&gws_rd=ssl#q=blank+cells+diagram (Blank cell templates)	
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 provide a writing template. The teacher may provide cloze method notes.	N/A
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)

	The teacher may have students research 3D cell organelle models and describe the limitations and benefits of these models versus the cell diagrams.	The student may create a digital model of a cell.
Critical Content:	• Vacuole, mitochondria, chloroplast	
Key Skills:	• Label a diagram	
Critical Language:	Vacuole, mitochondria, chloroplast, describe, label, recall, diagram	

Learning Experience # 2 - 4
Instructional Timeframe: Weeks 1-2

Learning Experience # 2		
The teacher may explore photosynthesis through a variety of means so that the students can describe the process, the organelles required, the purpose, and what organisms acquire energy through photosynthesis.		
Generalization Connection(s):	The process of photosynthesis uses organelles specific to plants to transform and store energy.	
Teacher Resources:	https://www.youtube.com/watch?v=_xeYNnzwpSE (Photosynthesis Basics video) https://www.youtube.com/watch?v=FiFA3lRFxjk (Plants/Photosynthesis Episode of Bill Nye – use excerpts) http://mrkaloudis.weebly.com/resources.html (Guided notes for above Bill Nye video) http://mrkaloudis.weebly.com/resources.html (Photosynthesis & Global Warming Article)	
Student Resources:	http://quizlet.com/subject/photosynthesis-vocabulary-middle-school/?imagesOnly=1 (vocabulary flashcards – some stacks are more advanced) http://www.sites.ext.vt.edu/virtualforest/modules/photo.html (Photosynthesis interactive)	
Assessment:	Students will create/complete a graphic organizer to include the following: • The organelle where photosynthesis occurs from a diagram of a cell. • A description of the process. • Three organisms that perform photosynthesis.	
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 cloze method notes. The teacher may provide a visual "cheat sheet" of a plant cell.	The student may name the organelle used rather than identify it from a diagram. The student may draw a diagram rather than describe the process in written form.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)

	The teacher may provide more detailed information about processes within the chloroplast (Krebs Cycle, Light & Dark Reactions, Electron Transport Chain, etc.). The teacher may provide more detailed information about the parts of a chloroplast (stroma, thylakoid, granum, etc.).	The student may include more detailed information within their graphic organizer.
Critical Content:	• Photosynthesis, chloroplast, chlorophyll, plant cell, stomata, vacuole, solar energy, chemical change, organelle, carbon dioxide, sugar • Knowledge of plant anatomy (leaves, roots, etc.)	
Key Skills:	• Comparing and contrasting plant and animal cells.	
Critical Language:	Photosynthesis, chloroplast, chlorophyll, plant cell, stomata, vacuole, solar energy, chemical change, roots, leaves, organelle, carbon dioxide, sugar, compare, contrast, identify, describe, complete, create	

Learning Experience # 3	
The teacher may lead a discussion and allow students to research how organisms utilize photosynthesis so that students can make generalizations about organisms that use photosynthesis and those that do not.	
Generalization Connection(s):	The process of photosynthesis uses organelles specific to plants to transform and store energy. Photosynthesis and cellular respiration are both chemical processes that support life through the transformation of light energy into a form of energy that is usable by organisms.
Teacher Resources:	http://www.cs.us.es/~fran/students/julian/organisms/organisms.html (Examples of organisms that use photosynthesis-higher level) http://cdn4.kidsdiscover.com/wp-content/uploads/2013/08/Photosynthesis-Infographic-Kids-Discover.png (Visual with explanations of photosynthesis) http://www.nps.gov/romo/learn/nature/plants.htm (List of plants in Rocky Mountain National Park) http://www.nps.gov/romo/learn/nature/plants.htm (List of Rocky Mountain native plants) http://www.nsf.gov/news/news_summ.jsp?cntn_id=110580 (Article on carbon dioxide and forest fire)
Student Resources:	http://photosynthesisforkids.com/ (description of photosynthesis) http://photosynthesiseducation.com/photosynthesis-for-kids/ (Photosynthesis for kids) http://www.cs.us.es/~fran/students/julian/organisms/organisms.html (Extension for photosynthesis) http://www.thunderboltkids.co.za/Grade6/01-life-and-living/chapter1.html# (Article on photosynthesis including activity)
Assessment:	Students will create a formal letter to the Department of National Parks from the perspective of a park ranger who is noticing higher carbon dioxide levels in Rocky Mountain National Park (RMNP). The letter must include: • 3 organisms* in the park that do photosynthesis and a justification of how they know those organisms do photosynthesis. • A connection between photosynthesis and why carbon dioxide levels might be increasing. *Teacher should provide students with a list of organisms that live in RMNP, including a variety of plant species, animal species, and bacteria.

Differentiation: (Multiple means for students to access content and multiple modes for students to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide a limited list of organisms for the assessment. The teacher may provide an outline of a formal letter including a completed address, salutation, and signoff. The teacher may provide extended time to complete the letter, aiding in formatting. The teacher may only require 2 organisms. The teacher may allow students to type the response rather than hand written.	The student may produce a limited response (only 1 paragraph, not in the template of a formal letter, etc.).
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may decide to not use a given list of organisms. The teacher may ask students to consider ways to decrease CO2 levels they outlined in their response to increasing levels.	The student may include considerations for decreasing CO2 levels in the letter to the park ranger.
Critical Content:	• Photosynthesis, plants, bacteria, solar energy, sugar, water, carbon dioxide, organism, protist	
Key Skills:	• Comparing and contrasting plants and animals	
Critical Language:	Justification, theory, formal letter, describe, photosynthesis, plants, animals, bacteria, solar energy, sugar, water, carbon dioxide, organism, protist	

Learning Experience # 4	
The teacher may present the chemical equation for photosynthesis through a laboratory experience so that students can differentiate between the reactants and the products, and provide a scientific explanation with evidence that demonstrates photosynthesis has occurred.	
Generalization Connection(s):	The process of photosynthesis uses organelles specific to plants to transform and store energy.
Teacher Resources:	http://www.indps.k12.wi.us/cms_files/resources/Notebooking ideas_including claim evidence reasoning.pdf (pg. 21-24; Claims-Evidence-Reasoning Template) https://www.youtube.com/watch?v=C1_uez5WX1o (Photosynthesis song) https://www.youtube.com/watch?v=x-t0sGyjfto(Photosynthesis rap) http://www.teachertube.com/video/photosynthesis-62625 (Photosynthesis rap) http://mrkaloudis.weebly.com/resources.html (Illuminating Photosynthesis Poem) http://mrkaloudis.weebly.com/resources.html (Equation Game – students each get a molecule and rearrange to form the equation) http://www.biologyjunction.com/5b-photoinleafdiskslesson.pdf (Spinach Leaf Discs Lab Set-up) http://mrkaloudis.weebly.com/resources.html (Spinach Leaf Discs Photosynthesis Lab Report)
Student Resources:	http://www.pbs.org/wgbh/nova/nature/photosynthesis.html (original interactive for Photosynthesis Poem)

<table>
<tr><td></td><td colspan="2">http://www.wonderville.ca/asset/photosynthesis(Interactive that breaks down the equation, reactants, and products)</td></tr>
<tr><td>Assessment:</td><td colspan="2">Students will complete a lab report using the Claims, Evidence, Reasoning (CER) format and includes:
• A data table
• A graph
• An equation for photosynthesis
• Labels for reactants and products
• An explanation with evidence of how photosynthesis is occurring</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 words rather than chemical formulas for the equation.
The teacher may provide a blank grid with the axes numbered.
The teacher may provide a word bank to help students complete a lab report or answer questions about the lab.
The teacher may allow students to work in small groups.</td><td>The student may complete only a Claims-Evidence-Reasoning template rather than a full lab report.</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 create a lab in which they investigate a different, more complex, organism.</td><td>The student may present their idea for a lab to the class and discuss how the process would or would not be similar to the one the teacher created for the class.</td></tr>
<tr><td>Critical Content:</td><td colspan="2">• Graph, equation, photosynthesis, reactant, product, yields, chemical reaction, H_2O, CO_2, $C_6H_{12}O_6$, glucose, solar energy, carbon dioxide, water</td></tr>
<tr><td>Key Skills:</td><td colspan="2">• Balancing and reading chemical equations
• Graphing
• Reading a data table
• Following experimental procedures
• Using lab supplies
• Completing steps of the scientific methods
• Creating a strong scientific explanation</td></tr>
<tr><td>Critical Language:</td><td colspan="2">Lab report, graph, identifying, data, evidence, scientific, data table, axis, title, units, equation, photosynthesis, reactant, product, yields, chemical reaction, H_2O, CO_2, $C_6H_{12}O_6$, glucose, solar energy, carbon dioxide, water</td></tr>
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Learning Experiences # 5-7
Instructional Timeframe: Weeks 2-4

Learning Experience # 5		
The teacher may introduce cellular respiration through various activities so that students can describe the process, the organelles required, the purpose, and what organisms acquire energy through cellular respiration.		
Generalization Connection(s):	Cellular respiration transforms and uses energy differently from photosynthesis.	
Teacher Resources:	https://www.youtube.com/watch?v=CNJYKgLRPJ0 (Introduction and summary of cellular respiration) http://www.ck12.org/book/CK-12-Life-Science-Concepts-For-Middle-School/r14/section/2.14/ (Cellular respiration key points) http://www.learner.org/courses/essential/life/session7/closer4.html (Brief overview of cellular respiration) http://images.pcmac.org/SiSFiles/Schools/AL/HooverCity/BumpusMiddle/Uploads/DocumentsCategories/Documents/photosynthesis%20and%20respiration%20GO%20answers.pdf (graphic organizer model) http://www.springlakeparkschools.org/sites/springlakeparkschools.org/files/users/tschwa/cell_2_vocabulary_chart.pdf (page 1 has a good graphic organizer for definitions)	
Student Resources:	https://www.youtube.com/watch?v=CNJYKgLRPJ0 (Introduction and summary of cellular respiration) https://www.youtube.com/watch?v=FHWbjnzfi_U (Cellular respiration song) http://www.learner.org/courses/essential/life/session7/closer4.html (Brief overview of cellular respiration) http://escambiaschools.org/L.18.9 (Brief self-quiz) http://www.biology-questions-and-answers.com/cell-respiration.html (Student resources for extension opportunities)	
Assessment:	Students will complete a graphic organizer demonstrating the role of organelles during cellular respiration (e.g., mitochondria, cell membrane), discuss the specific purpose for this process, and list three real-world examples of organisms that utilize cellular respiration.	
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 cloze style (partially completed) graphic organizer.	The student may demonstrate the graphic organizer and knowledge of organisms that use cellular respiration verbally.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)

	The teacher may provide more in depth information such fermentation and lactic acid build-up. http://tinyurl.com/jw8fnab (PowerPoint presentation expanding upon fermentation and lactic acid energy paths) The teacher may provide more detail about internal components and processes within mitochondria. The teacher may provide resources to research alternative methods of cellular respiration (journal articles, videos, etc.) https://gln.dcccd.edu/Biology_Demo/Bio_Lesson08/Bio08-16_access.htm (In-depth article on fermentation) http://southwest.mpls.k12.mn.us/uploads/respiration.ppt.pdf (PowerPoint describing metabolic pathways of alternative energy production)	The student may provide understanding of alternative methods of cellular respiration in the graphic organizer.
Critical Content:	• Sugar, Oxygen, Mitochondria, Eukaryotic Cells, Water, Carbon Dioxide, Energy, Chemical Change, Cellular Respiration	
Key Skills:	• Complete a graphic organizer • Digital research skills	
Critical Language:	Organelle, function, cellular, respiration, organism, eukaryotic	

Learning Experience # 6	
The teacher may provide research opportunities to explore cellular respiration and photosynthesis so that students can compare and contrast the processes in different organisms.	
Generalization Connection(s):	Cellular respiration transforms and uses energy differently from photosynthesis. Photosynthesis and cellular respiration are both chemical processes that support life through the transformation of light energy into a form of energy that is usable by organisms.
Teacher Resources:	http://tinyurl.com/nwpqgq2 (PowerPoint presentation exploring BOTH photosynthesis and cellular respiration) https://www.youtube.com/watch?v=JUmT24R8CyA (video tying two processes together) http://www.teachertube.com/video/cellular-respiration-and-photosynthesis-159339 (video animation showing both processes) https://sites.google.com/site/mochebiologysite/online-textbook/photosynthesis (overview of both photosynthesis and cellular respiration) http://www.springlakeparkschools.org/sites/springlakeparkschools.org/files/users/tschwa/p-r_worksheet.pdf (worksheet to review)
Student Resources:	http://tinyurl.com/m2sldwx (Guided notes on both processes) http://www2.mbusd.org/staff/pware/PDFPPT/CellularRespiration.pdf (Power Point on cellular respiration) http://www.springlakeparkschools.org/sites/springlakeparkschools.org/files/users/tschwa/p-r_comparison.pdf (comparison of chemical reactions)
Assessment:	Students will compare and contrast, through constructed response, their research-based findings. They must include:

	• Two examples of organisms that perform cellular respiration, two that perform photosynthesis, and one that does both • Identify the location (e.g., chloroplasts v. mitochondria) where photosynthesis and cellular respiration occur • The purpose of photosynthesis and the purpose of cellular respiration

Differentiation: (Multiple means for students to access content and multiple modes for students to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teachers may provide specific sources for students' reading level. The teacher may provide a check-list for required information. http://tinyurl.com/k2y3fnm (check list for compare and contrast essay) http://www.biologycorner.com/resources/graphic_compare_contrast.gif (graphic organizer for any compare and contrast essay) The teacher may allow small group work.	The student may demonstrate their understanding verbally or visually. The student may provide a graphic organizer summarizing information attained.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teachers may allow students to research chemosynthesis, fermentation, or other alternative energy processes. http://tinyurl.com/jw8fnab (PowerPoint presentation expanding upon fermentation and lactic acid energy paths) http://oceanexplorer.noaa.gov/facts/photochemo.html (Chemosynthesis at ocean vents) http://ocean.si.edu/ocean-videos/hydrothermal-vent-creatures (Website to consider for chemosynthesis)	The student may create and share a model for the process they researched.
Critical Content:	• Photosynthesis, organelles, cellular respiration, organisms	
Key Skills:	• compare/contrast photosynthesis and cellular respiration, digital research skills	
Critical Language:	Photosynthesis, organelles, cellular respiration, organisms, acquire, principles	

Learning Experience # 7	
The teacher may lead a laboratory exercise exploring the chemical equation for cellular respiration so that students can differentiate between the reactants and products, and provide a scientific explanation with evidence that demonstrates cellular respiration has occurred.	
Generalization Connection(s):	Cellular respiration transforms and uses energy differently from photosynthesis.
Teacher Resources:	http://www.chem.ufl.edu/~saacs/outreach/Blow%20Up%20a%20Balloon%20with%20Cellular%20Respiration.pdf (Classroom lab

<table>
<tr><td></td><td colspan="2">description)
http://www.imcpl.org/kids/blog/?p=9601 (Lab resources and information for different labs)
http://bhhs.bhusd.org/apps/download/ZIL0voWgdwXIV57od7eE2OeiK1fTQ8zdB03AovyLgzW7JJMY.pdf/4_4%20Study%20Guide%20Overview%20of%20Cellular%20Respiration%20Worksheet%20_KEY_.pdf (Information worksheet that could also be used as assessment)
http://www.tcss.net/cms/lib3/AL01001644/Centricity/Domain/4299/Respiration%20Webquest.pdf (Webquest)
http://www.sumanasinc.com/webcontent/animations/content/cellularrespiration.html (video clip)
http://mrkaloudis.weebly.com/resources.html (equation game)
http://images.pcmac.org/SiSFiles/Schools/AL/HooverCity/BumpusMiddle/Uploads/DocumentsCategories/Documents/Cellular%20Respiration%20Activity.pdf (lab report worksheet)</td></tr>
<tr><td>Student Resources:</td><td colspan="2">http://bhhs.bhusd.org/apps/download/ZIL0voWgdwXIV57od7eE2OeiK1fTQ8zdB03AovyLgzW7JJMY.pdf/4_4%20Study%20Guide%20Overview%20of%20Cellular%20Respiration%20Worksheet%20_KEY_.pdf (only certain parts applicable for students)
http://www.tcss.net/cms/lib3/AL01001644/Centricity/Domain/4299/Respiration%20Webquest.pdf (Webquest)
http://www.springlakeparkschools.org/sites/springlakeparkschools.org/files/users/tschwa/p-r_comparison.pdf (comparison of chemical reactions)</td></tr>
<tr><td>Assessment:</td><td colspan="2">Students will complete a lab report demonstrating how an organism releases CO2 (Carbon Dioxide) during the process of cellular respiration. Students will answer critical response questions, present their data in a graph, and draw conclusions based on evidence.</td></tr>
<tr><td rowspan="2">Differentiation:
(Multiple means for students to access content and multiple modes for students to express understanding.)</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>Teachers may allow students to work in a small group setting
Teachers may provide x-axis and y-axis information.</td><td>Students may present their conclusions verbally
Students may present their lab report visually (poster, PowerPoint, etc).</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>Teachers may provide students with additional independent variables such as milk, cold vs. hot water, soda, etc.</td><td>Students may present their lab report in a digital format (voicethread, prezi, etc.)</td></tr>
<tr><td>Critical Content:</td><td colspan="2">• Chemical equation for cellular respiration, chemical reaction, ATD, ADP, H2O, CO2, Glucose (sugar), reactants and products, law of conservation of energy, graph, equation, yields</td></tr>
<tr><td>Key Skills:</td><td colspan="2">• Balancing and reading chemical equations
• Graphing
• Reading a data table
• Following experimental procedures
• Using lab supplies
• Steps of scientific method
• What makes a strong scientific explanation</td></tr>
<tr><td>Critical Language:</td><td colspan="2">Lab report, graph, identifying, data, evidence, scientific, data table, axis, title, units, equation, photosynthesis, reactant, product, yields, chemical reaction, H2O, CO2, glucose,</td></tr>
</table>

Learning Experiences # 8-10
Instructional Timeframe: Week 4

Learning Experience # 8		
The teacher may use various simulations of real-world occurrences so that students can explore the interconnectedness of photosynthesis and cellular respiration.		
Generalization Connection(s):	Photosynthesis and cellular respiration are both chemical processes that support life through the transformation of light energy into a form of energy that is usable by organisms.	
Teacher Resources:	http://www.mysciencebox.org/cellenergy (cell energy activities) http://www.ck12.org/life-science/Connecting-Cellular-Respiration-and-Photosynthesis-in-Life-Science/lesson/Connecting-Cellular-Respiration-and-Photosynthesis/ (article on how respiration and photosynthesis are connected)	
Student Resources:	https://www.youtube.com/watch?v=JUmT24R8CyA (video lesson on the interconnectedness of cellular respiration and photosynthesis) http://www.biomanbio.com/GamesandLabs/PhotoRespgames/phorespgame.html (photosynthesis and respiration game)	
Assessment:	Students will create a product (e.g., poem, story, song) demonstrating that the products of one process are the reactants of the other.	
Differentiation: (Multiple means for students to access content and multiple modes for students to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide a Skeleton poem (cloze method).	N/A
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to explore experiences of plant adaptation in relation to cellular respiration and energy transport.	The student may create a (Prezi, video, Power Point, ect.) of their findings.
Critical Content:	• How H20 enters plant • Photosynthesis equation CO2+H2O to C6H12O6+O2 • ATP is the energy gained	
Key Skills:	• Differentiate between reactants and products • Analyzing the relationship between cellular respiration and energy transport. • Compare/contrast organisms involved.	
Critical Language:	Glucose, Chemical reaction, Reactants, Products, Solar energy, ATP, compare and contrast, differentiate, analyze	

Learning Experience # 9		
The teacher may create an environment for discussion around increased carbon emissions so that students can model the role of photosynthesis and cellular respiration in the natural world.		
Generalization Connection(s):	Photosynthesis and cellular respiration are both chemical processes that support life through the transformation of light energy into a form of energy that is usable by organisms.	
Teacher Resources:	http://mrspratts7thgradelifescience.blogspot.com/p/projects-and-labs.html (Features of living things project)	
Student Resources:	http://www.giss.nasa.gov/research/news/20140717 (Ocean probe on carbon cycle (Goodard)) http://www.ncdc.noaa.gov/sotc/global (Global Analysis of Co2 emmissions) http://www.geocraft.com/WVFossils/last_400k_yrs.html (Simplified data from Vostok) http://www.giss.nasa.gov (Goodard site for other reading interests) http://climate.nasa.gov/vital-signs/global-temperature (Interactive temperature slide relative to averages between 1951-1980) http://environment.nationalgeographic.com/environment/global-warming/deforestation-overview (site for potential research) http://earthobservatory.nasa.gov/Features/Deforestation/deforestation_update3.php (site for potential research) http://www.wsj.com/articles/commercial-farming-causes-nearly-half-of-illegal-tropical-deforestation-1410393662 (site for potential research) http://www.sciencedaily.com/articles/d/deforestation.htm (site for potential research) http://co2now.org/current-co2/co2-now/annual-co2.html (Site for annual atmospheric data-realizing the global average is ~300 ppm during this glacial cycle) http://www.pmel.noaa.gov/co2/story/Ocean+Carbon+Storage (site for potential research) https://www.youtube.com/watch?v=xcVwLrAavyA (global warming Tom Brokaw) http://topdocumentaryfilms.com/acid-test-global-challenge-ocean-acidification (ocean documentary) http://grist.org/article/2009-06-08-ocean-acidification-film (Film about ocean acidity) http://topdocumentaryfilms.com/doomsday-called-off (another version to global warming) http://scienceandpublicpolicy.org/monckton/goreerrors.html (Science and Public Policy Institute)	
Assessment:	Students will create a persuasive product (e.g., poster, flyer) of a chosen real-world example that represents the relationship between photosynthesis and cellular respiration.	
Differentiation: (Multiple means for students to access content and multiple modes for students to express understanding.)	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow small group opportunities The teacher may provide a model The teacher may provide a partially completed script	The student may produce a graphic organizer The student may demonstrate knowledge through illustration.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to explore their community and find avenues to lesson amounts of carbon emissions	The student may create a (Prezi, video, Power Point, ect.,) of their findings. The student may create a video or report of their findings and suggestions for improvements.
Critical Content:	• Greenhouse effect on local environment	

	• Photosynthesis • cellular respiration • deforestation
Key Skills:	• Evaluate cause/effect of deforestation • Analyze human interventions • Modeling the relationship between photosynthesis and cellular respiration within the carbon cycle.
Critical Language:	Greenhouse effect, photosynthesis, cellular respiration, deforestation

Learning Experience # 10		
The teacher may guide students through an exploration of conservation of energy so that students can explain how energy is transferred, conserved, and stored within an ecosystem.		
Generalization Connection(s):	Photosynthesis and cellular respiration are both chemical processes that support life through the transformation of light energy into a form of energy that is usable by organisms.	
Teacher Resources:	http://www.rcsnc.org/UserFiles/Servers/Server_4702937/File/lynne%20huskey/FoodChainGang.pdf This site allows for diverse assessment opportunities, but for our purpose, pgs 26 with answer key on pg 28 can be used for this assessment. http://www.nature.com/scitable/blog/our-science/no_trees_no_humans (video - Everglades food chain) http://huckleberryfinnclc.weebly.com/producers.html (simple visual with explanation of energy transfer in a food chain)	
Student Resources:	http://www.hobart.k12.in.us/jkousen/Biology/phobig.html Vocabulary/tutor http://www.biomes.com extension http://www.nature.com/scitable/blog/our-science/no_trees_no_humans (video - Everglades food chain) http://www.ecokids.ca/pub/eco_info/topics/frogs/chain_reaction/play_chainreaction.cfm (interactive food chain game)	
Assessment:	Students will complete a short constructed response about sources of energy within a food chain that is provided. They will need to trace the energy being transferred to and from each organism to ultimately describe the original source of energy. • Explain how each organism obtains the energy it needs to function • Explain how energy is transferred • Where does the last organism in the food chain ultimately get its energy from?	
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 students with a food chain template. The teacher may provide a word bank of organisms. The teacher may adjust the number of organisms within the food chain. The teacher may provide a cloze method for writing assignment.	The student may label the food chain with short descriptions of each step within the chain.

Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow students to include decomposition within their descriptions of the food chain.	The student may produce a food web that describes the cumulative relationship amongst the organisms.
Critical Content:	• Organism • Food chain • Energy is transferred from organism to organism, not created (Law of conservation of Energy)	
Key Skills:	• Explain how each organism obtains the energy it needs to function • Explain how energy is transferred • Analyze and interpret a model	
Critical Language:	Organism, food chain, energy transformation, explain, model, interpret, analyze, conservation	