Colorado Teacher-Authored Instructional Unit Sample

Science
7th Grade

Unit Title: Geologic Events Through Time

INSTRUCTIONAL UNIT AUTHORS

Ellicott School District
- Anja Centennial
- Diana Ford
- Nicholas Kaloudis
- Michael Webb
- Corey Zukie

Hanover School District
- Kimberly Barre

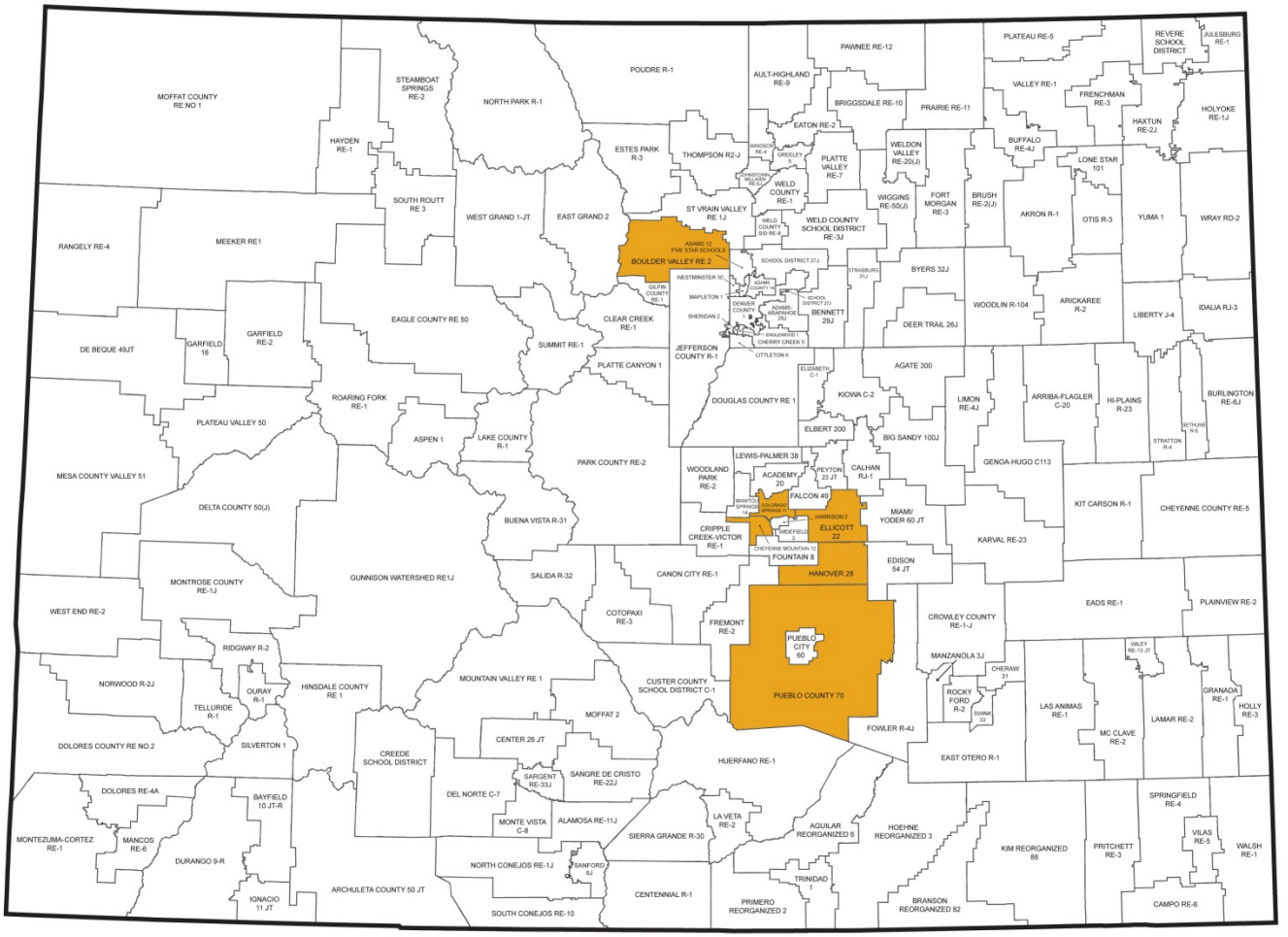
BASED ON A CURRICULUM OVERVIEW SAMPLE AUTHORED BY

Colorado Springs School District
- Grace C. Wright

Cheyenne Mountain School District
- Jonathan D. Ogg

Pueblo County School District
- Nicole A. Amidei

Boulder Valley School District
- Samantha Messier



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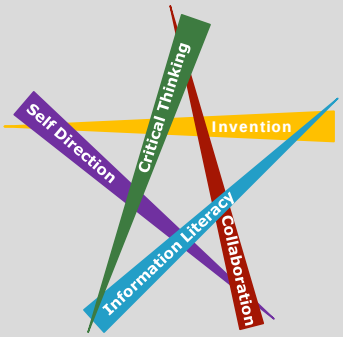
Content Area	Science	Grade Level	7th Grade
Course Name/Course Code			

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
Geologic Events Through Time	7-8 weeks	5

Unit Title	Geologic Events Through Time		**Length of Unit**	7-8 weeks
Focusing Lens(es)	Change Time	**Standards and Grade Level Expectations Addressed in this Unit**	SC09-GR.7-S.3-GLE.2 SC09-GR.7-S.2-GLE.5	
Inquiry Questions (Engaging-Debatable):	● How would the world be different if organisms and the environment did not change over time? ● How is it helpful to our understanding of time and Earth's history to track time through geology? ● Why is it challenging for people to think in terms of geologic time?			
Unit Strands	Earth Science, Life Science			
Concepts	Order, Change, Evolution, Time, Interaction, organism, environment, extinction, structure, scale, traits, evidence			

Generalizations **My students will Understand that…**	**Guiding Questions** **Factual**	**Conceptual**
Geologic time, observed in land formations and rock layers, indicate major change events in Earth's history (SC.09-GR.7-S.3-GLE.2-EO.b,c,d; IQ.1; RA.1)	How can major geologic events be attributed to plate movement? (SC.09-GR.7-S.3-GLE.1;IQ.1)	Why is understanding Earth's geologic history important today? (SC.09-GR.7-S.3-GLE.2-EO.c)
Evidence is used to determine the order of events in geologic time. (SC.09-GR.7-S.3-GLE.2-EO.d)	How do people know which layer of rock is older? (SC.09-GR.7-S.3-GLE.2-EO.c; RA.1;N.2)	Why are fossils important in understanding geologic history? (SC.09-GR.7-S.3-GLE.2-EO.c; RA.1;N.2)

Critical Content: **My students will Know…**	**Key Skills:** **My students will be able to (Do)…**
● Major events in Earth's geologic history (SC.09-GR.7-S.3-GLE.2-EO.c) ● The causes and effects of mass extinction (SC09-GR.7-S.2-GLE.5-EO.c,d) ● Fossil records used to study the geological/biological history of the Earth (past and present) (SC.09-GR.7-S.3-GLE.2-EO.d) ● The difference between absolute and relative fossil dating (SC.09-GR.7-S.3-GLE.2; RA.2) ● The geologic time scale and sequence of geologic events (SC.09-GR.7-S.3-GLE.2-EO.a) ● The difference between direct and indirect evidence (SC.09-GR.7-S.3-GLE.2-EO.d)	● Identify, describe, and determine the sequence of major events in Earth's geologic history by examining rock layers, fossil records, and other geologic evidence. (SC.09-GR.7-S.3-GLE.2-EO.c,d) ● Analyze and critique causes and effects of mass extinction and use technology to share findings (SC.09-GR.7-S.2-GLE.5-EO.b,d) ● Describe the geologic time scale and why it is used (SC.09-GR.7-S.3-GLE.2-EO.a) ● Identify and describe the impact of major geologic events on life on Earth (SC.09-GR.7-S.3-GLE.2-EO.b) ● Identify and describe major events in Earth's geologic history (SC.09-GR.7-S.3-GLE.2-EO.c) ● Use direct and indirect evidence to determine the sequence of events in geologic time (SC.09-GR.7-S.3-GLE.2-EO.d) ● Interpret and analyze data from the fossil record to support a claim that organisms

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):	*Geologic time is shown and scaled through rock layers, fossil records, and other geological evidence.*
Academic Vocabulary:	Theory, time scale, layers, analyze, succession, sequence, simulation, models
Technical Vocabulary:	Geologic time, fossil record, fossil, lithosphere, sedimentation

Unit Description:	This unit focuses on discovering the history of Earth by interpreting rock layers and their contents (e.g., fossils, composition of rocks). Students will explore how major events are used to divide history into eons, era, and periods, as well as how fossils are formed. This unit culminates in a performance assessment where students are paleontologists asked to investigate a geologic column and create a geologic time scale.
Considerations:	This unit was created with the intention of following the *Shake, Rattle and Roll* unit. The original unit had four generalizations, however this unit removed two and added those generalizations into the adaptations unit for a better fit. **Misconceptions:** The Earth is not approximately 4.6 billion years old. All dead organisms become fossils. Fossils are always the actual bones of the organisms. Dinosaurs and humans were on the planet at the same time. All the eons are equal amounts of time. Dinosaurs all lived at the same time. All forms of life began at the same point in time. Life began on land. Only animal life can become fossilized.
Unit Generalizations	
Key Generalization:	Evidence is used to determine the order of events in geologic time.
Supporting Generalizations:	Geologic time, observed in land formations and rock layers, indicate major change events in Earth's history.

Performance Assessment: *The capstone/summative assessment for this unit.*	
Claims: (Key generalization(s) to be mastered and demonstrated through the capstone assessment.)	Evidence is used to determine the order of events in geologic time.
Stimulus Material: (Engaging scenario that includes role, audience, goal/outcome and explicitly connects the key generalization)	A company was contracted by the National Science Foundation to extract a geologic column. They have asked you, a paleontologist, to investigate this geologic column. The goal of this investigation is for you to explain the history of what has happened in the area where the column was pulled. • You must create a geologic time scale that outlines major events that shaped this area modeled on Earth's geologic time scale. • You must create your own name for various eons and eras, indicating when major events occurred. • You must include evidence of life, the age of various rock layers, and other evidence that leads you to your explanations of the column.

Product/Evidence: (Expected product from students)	A company was contracted by the National Science Foundation to extract a geologic column. Students will take the role of a paleontologist, to investigate this geologic column. The goal of this investigation is for them to explain the history of what has happened in the area where the column was pulled. • They must create a geologic time scale that outlines major events that shaped this area modeled on Earth's geologic time scale. • They must create your own name for various eons and eras, indicating when major events occurred. • They must include evidence of life, the age of various rock layers, and other evidence that leads you to your explanations of the column.
Differentiation: (Multiple modes for student expression)	The teacher may limit the number of eons or eras. The teacher may provide a geologic scale and then students order events based on column. The teacher may want to change the environment to another planet, various locations, etc. Teachers may allow students to produce an outline, create a time scale from scratch, use a narrative form, a paragraph, a Prezi, etc. The teacher may create the column as simple or complicated as necessary to meet students' needs.

Texts for independent reading or for class read aloud to support the content	
Informational/Non-Fiction	**Fiction**
Alvarez, W. (2008). *T. Rex and the Creator of Doom.* Lexile: 1380L DK Publishing. (2009). *Prehistoric Life.* Lexile: 1130L. Collard, S. (2008). *Reign of the Sea Dragons.* Lexile: 1100L. Agenbroad, L. & Nelson, L. (2002). *Mammoths: Ice Age Giants.* Lexile: 1180L. Harrison, D. (2007). *Cave Detectives: Unraveling the Mystery of an Ice Age Cave.* Lexile: 920L Lauber, P. (1992). *Dinosaurs Walked Here and Other Stories Fossils Tell.* Lexile: 1060L. Walker, S. (2013). *Figuring Out Fossils.* Lexile: 600L. Brown, D. (2003). *Rare Treasure: Mary Anning and Her Remarkable Discoveries.* Lexile:840L	Crichton, M. (1995). *The Lost World.* Lexile: 670L. Verne, J. (2006). *Journey to the Center of the Earth.* Lexile: GN500L Crichton, M. (1990). *Jurassic Park.* Lexile: 710L. National Geographic Learning. (2007). *Digging into the Ice Age.* Lexile: 620L Bailey, L. (2004). *Adventures in the Ice Age.* Lexile: 740L Banks, K. (2001). *A Gift From the Sea.* Lexile: AD680L. Bakker, R. (1996). *Raptor Red.* Lexile: 1080L.

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:	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 have a basic understanding of the types of rocks, primarily sedimentary. Vertical Articulation: The last time students have seen the concepts within this unit was in 4th grade.

Learning Experience # 1	
The teacher may provide examples of various time lines (i.e., chronologically, event, interval) so that students can begin to understand that time can be broken down in different ways.	
Generalization Connection(s):	Evidence is used to determine the order of events in geologic time. (SC.09-GR.7-S.3-GLE.2-EO.d)
Teacher Resources:	http://www.dynamicearth.co.uk/media/1514/geological-timeline-pack.pdf (geological timeline information and activities) http://www.uky.edu/KGS/education/clockstime.htm (example of geologic time on a daily clock) http://www.whenwecrosswords.com/crossword/geologic_time_scale/36464/crossword.jsp (pre-made crossword puzzle with answer key) http://www.fossilmuseum.net/Paleobiology/Paleozoic_paleobiology.htm (links for all time lines to include graphs, maps, and added links while reading) http://www.nature.com/scitable/knowledge/library/dating-rocks-and-fossils-using-geologic-methods-107924044 (reading component) http://kids.britannica.com/comptons/art-107857/The-geologic-time-scale-showing-major-evolutionary-events-from-650 (printable time line chart) http://www.britannica.com/EBchecked/topic/129392/community-ecology/images-videos/24/evolution-plant-timeline (graph of plant timeline) https://www.youtube.com/watch?v=7PQURsc2SYs&noredirect=1 (Time scale song/video) http://www.stuegli.com/phyzx/personaltimeline.htm (create a personal geologic time scale)
Student Resources:	https://signalvnoise.com/images/grs02_03.gif (geological events on a football field) http://www.uky.edu/KGS/education/clockstime.htm (example of geologic time on a daily clock) http://science.nationalgeographic.com/science/prehistoric-world/prehistoric-time-line (student interactive) http://www.adonline.id.au/plantevol/evolution-timeline/ (Plant Evolution Timeline interactive) http://www.purposegames.com/game/318 (Time line interactive) http://www.bobainsworth.com/fossil/Earths_timeline_dw[1].swf (Earth time line Interactive) http://www.dynamicearth.co.uk/media/1514/geological-timeline-pack.pdf (geological timeline information and activities) http://www.nhm.ac.uk/nature-online/life/human-origins/modern-human-evolution/early-beginnings/ (Human time-line)
Assessment:	Students will create a personal time scale/ timeline mirroring the geologic time scale. http://www.stuegli.com/phyzx/personaltimeline.htm

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 template of the timeline. The student may complete cut and paste events into a pre-assembled timeline.	The students may create a simple timeline of a period of their lives/ of major events in their lives.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide additional resources (video, PowerPoint) to expand understanding of temperatures at various depths.	The students may create an annotated timeline with a summary of each event.
Critical Content:	● The separation of the geologic timeline	
Key Skills:	● Sequencing events, correlating variables, identify events	
Critical Language:	Chronological, timeline, label, density, gravity, solidification, billion, timeline, crust, molten, sequencing events, correlating variables, identify events, impact event	

Learning Experience # 2	
The teacher may introduce important events in time (i.e., ice age, mass extinction, impact event, evolution of life) so that students can comprehend how the geologic time scale was created and divided into eons, eras, periods, and epochs.	
Generalization Connection(s):	Evidence is used to determine the order of events in geologic time. (SC.09-GR.7-S.3-GLE.2-EO.d)
Teacher Resources:	http://www.uky.edu/KGS/education/clockstime.htm (example of geologic time on a daily clock) http://www.bbc.co.uk/nature/extinction_events (mass extinction events) http://www.vox.com/2014/3/28/5550604/what-is-mass-extinction (video) http://tinyurl.com/kn834um ("Humans Caused Mass Extinction of Large Ice Age Animals Not Climate Change") http://tinyurl.com/kzc22f9 ("Asteriod Strike Confirmed as Dinosaur Killer" Smithsonian video embedded) http://archive.fieldmuseum.org/evolvingplanet/POST/EP_V8.swf (Informational Interactive with nice images) ttp://www.adonline.id.au/plantevol/evolution-timeline/ (Plant Evolution Timeline) http://www.bbc.co.uk/nature/extinction_events (mass extinction events) https://kraynaksciencewiki.wikispaces.com/Geologic+Time+Project+and+Webquest (web Quest for Paleozoic, Mesozoic, and Cenozoic era's) http://www.hhmi.org/biointeractive/day-mesozoic-died (scroll down for mass extinction video)
Student Resources:	https://signalvnoise.com/images/grs02_03.gif (geological events on a football field) http://www.uky (Time clocks) .edu/KGS/education/clockstime.htm (example of geologic time on a daily clock) http://tinyurl.com/npjfjbu (Geologic timeline with events) http://paleobiology.si.edu/geotime/main (Smithsonian click on period for information)

	http://archive.fieldmuseum.org/evolvingplanet/POST/EP_V8.swf (Informational Interactive with nice images) http://deeptime. info/ (interactive for this standard) http://www.readwritethink.org/classroom-resources/student-interactives/timeline-30007.html (Time-line interactive) ttp://www.adonline.id.au/plantevol/evolution-timeline/ (Plant Evolution Timeline)	
Assessment:	Students will create a geologic timeline identifying major geologic events that delineate the division of time.	
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 timeline template. The teacher may provide a word bank. The teacher may provide illustrations.	The student may develop the timeline using their own illustrations or by correctly ordering those provided.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may allow access to resources that detail smaller divisions of time.	The student may identify events that delineate smaller divisions of time.
Critical Content:	• Major divisions of Geologic Time	
Key Skills:	• Identifying major Earth events	
Critical Language:	Ice age, mass extinction, impact event, predict, era, eon, epoch, period, sequence, divisions	

Learning Experience # 3	
The teacher may lead a discussion on eons so that students can describe what the Earth was like during each eon and explain what led to the Cambrian explosion.	
Generalization Connection(s):	Evidence is used to determine the order of events in geologic time. (SC.09-GR.7-S.3-GLE.2-EO.d)
Teacher Resources:	http://www.windows2universe.org/earth/geology/hist_paleozoic.html (links to all periods for interactive, graphs, models, etc.,) ttp://www.adonline.id.au/plantevol/evolution-timeline/ (Plant Evolution Timeline) http://www.rocksinmyheadtoo.com/TimeLine.htm (charts and added links) http://tinyurl.com/77pod59 ("Geologic Time Scale" research interactive) http://biologos.org/questions/cambrian-explosion ("Does the Cambrian Explosion Pose a Challenge to Evolution?) https://www.fieldmuseum.org/sites/default/files/jsandy/2014/08/07/epguide1.pdf ("Evolving Planet Educating Guide) http://www2.humboldt.edu/natmus/e_LifeThroughTime.html (Life Through Time Exhibit) https://geologicaltime.wikispaces.com/wiki/changes (links to all eras)
Student Resources:	http://archive.fieldmuseum.org/evolvingplanet/POST/EP_V8.swf (Informational Interactive with nice images) http://palaeo.gly.bris.ac.uk/Communication/Willson/climatechange.html (Time period and climate interactive) http://www.nationalgeographic.com/features/96/dinoeggs/ (Dinosaur hunt interactive) http://www.regentsearth.com/Animations/Erosion&Deposition/GreatLakesFormation%28Pearson%29.swf (forming great lakes) http://www.rocksinmyheadtoo.com/TimeLine.htm (charts and added links) http://tinyurl.com/77pod59 ("Geologic Time Scale" research interactive) http://www.fossilmuseum.net/Paleobiology/CambrianExplosion.htm ("The Cambrian Explosion" virtual fossil museum) http://www.pbs.org/wgbh/evolution/library/03/4/l_034_02.html ("The Cambrian Explosion" animation)

	http://evolution.berkeley.edu/evolibrary/article/_0/cambrian_01 ("Meet the Cambrian Critters" animation interactive)	
Assessment:	Students will write a news report on the Cambrian explosion noting environmental factors before and after the 'explosion'.	
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)
	N/A	The student may create an artistic poster describing the Cambrian Explosion, noting environmental factors.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide video equipment.	The student may create a video or digital presentation of a "news show" describing the Cambrian Explosion and its' environmental factors.
Critical Content:	• The Cambrian Explosion • Flora and fauna of each eon	
Key Skills:	• Describe Earth during each eon.	
Critical Language:	Eon, Cambrian Explosion, Hadean, Archean, Proterozoic, Phanerozoic	

Learning Experience # 4		
The teacher may lead a discussion around the events that mark the beginning and end of different eras so that students can evaluate the eras in the Phanerozoic eon based on why and how the eras are separated.		
Generalization Connection(s):	Evidence is used to determine the order of events in geologic time. (SC.09-GR.7-S.3-GLE.2-EO.d)	
Teacher Resources:	http://paleobiology.si.edu/geotime/main (Smithsonian great student resource as well click on period for information) http://geneticsrules.weebly.com/geologic-time-scale-brochure-project.html (Instructions, rubric, and sites for a brochure project) http://www.windows2universe.org/earth/geology/hist_paleozoic.html (links to all periods for interactive, graphs, models, and much more) http://tinyurl.com/kzf5abd (color printable timeline with pictures) teachers.henrico.k12.va.us/godwin/strine_r/ghswebpage/geotime.ppt (simple explanation for divisions Power Point) http://lhsblogs.typepad.com/files/geologic_time_webquest.pdf (work sheet to explore all eras)	
Student Resources:	http://paleobiology.si.edu/geotime/main (Smithsonian click on period for information) http://science.nationalgeographic.com/science/prehistoric-world/prehistoric-time-line (student interactive) http://palaeos.com/phanerozoic/phanerozoic.htm (overview of the Phanerozoic eon) http://www.ck12.org/book/CK-12-Earth-Science-Concepts-For-Middle-School/section/11.24/ (brief overview of the Phanerozoic eon) http://tinyurl.com/lnj5wrf ("Biodiversity Flourishes in the Phanerozoic eon" Kahn Academy video") http://www.corzakinteractive.com/earth-life-history/00b_geologic_time.htm (interactive time line for Phanerozoic eon)	
Assessment:	Students will create a table of the 3 eras in the Phanerozoic identifying major events that marked the end and beginning of those eras and listing major life forms present during each of those eras.	
Differentiation: (Multiple means for students to access content and multiple modes for student to	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide a partially completed table (Cloze). The teacher may provide photos of animals that can be pasted	The student may cut and paste photos into the correct eras.

express understanding.)	into the correct eras.	
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	https://www.lucidpress.com/pages/examples/free-brochure-maker-online (free brochure maker)	The student may design a brochure on events separating time periods.
Critical Content:	● The division of the formation of life	
Key Skills:	● Distinguish each era in the Phanerozoic Eon.	
Critical Language:	Eon, era, Cenozoic, Mesozoic, Paleozoic, extinction	

Learning Experience # 5		
The teacher may use various methods to introduce the Paleozoic and Mesozoic Era so the student can begin to understand that life is complex and developed over time through transformation, originating from the oceans to terrestrial life.		
Generalization Connection(s):	Evidence is used to determine the order of events in geologic time. (SC.09-GR.7-S.3-GLE.2-EO.d)	
Teacher Resources:	http://www.fossils-facts-and-finds.com/paleozoic_era.html (links for printable student sheets, activities, articles, and much more) http://www.windows2universe.org/earth/geology/hist_paleozoic.html (links to all periods for interactive, graphs, models, and much more) http://palaeos.com/paleozoic/carboniferous/carboniferous.htm (map, time line, climate, etc,.) http://scienceviews.com/dinosaurs/paleozoic.html "(The Paleozoic Era" Periods, Tectonic, Environment) http://tinyurl.com/lru4oem (Paleozoic animal images) http://tinyurl.com/lzsgqr6 (images for Paleozoic world maps) https://www.youtube.com/watch?v=MZGzMwoEguU ("Physical Geography: Life During the Paleozoic era) http://www.wired.com/2010/11/huge-dragonflies-oxygen/ ("High Oxygen Levels Spawn Monster Dragonflies")	
Student Resources:	http://science.nationalgeographic.com/science/prehistoric-world/prehistoric-time-line (student interactive) http://fossils.valdosta.edu/era_paleozoic.html (reading and interactive for paleozoic era) http://www.corzakinteractive.com/earth-life-history/415_mississippian.htm (interactive for the paleozoic era) http://www.hhmi.org/biointeractive/day-mesozoic-died (short video) http://deeptime.info/ (interactive for complete timeline) http://www.corzakinteractive.com/earth-life-history/414_devonian.htm (Devonian Period) http://www.livescience.com/38596-mesozoic-era.html (use as a tutor research resource) http://tinyurl.com/lru4oem (Paleozoic animal images)	
Assessment:	Students will compare ocean life forms to their terrestrial counterparts, detailing the time when each animal would have most likely moved to land and why. The information will be presented in an illustrated short constructed response.	
Differentiation:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
(Multiple means for students to access content and multiple modes for student to express understanding.)	The teacher may provide resources for the artwork. The teacher may assign a specific organism.	The student may use clip art or photos.

Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	N/A	The student may create a digital animation or video fulfilling the above requirements.
Critical Content:	● Eras within the Phanerozoic Eon	
Key Skills:	● Identifying key features on a world map.	
Critical Language:	Terrestrial, Paleozoic, Mesozoic, Cenozoic, marine, Phanerozoic, era, eon	

Learning Experience # 6		
The teacher may provide opportunities to explore cross sections of rock so that student can compare and contrast absolute and relative dating and learn to use direct and indirect evidence to interpret the sequence of events in geologic time.		
Generalization Connection(s):	Evidence is used to determine the order of events in geologic time Geologic time, observed in land formations and rock layers, indicate major change events in Earth's history	
Teacher Resources:	http://tinyurl.com/qcrc34q (Lab to assist with half-life) http://www.teq.com/blog/2009/09/hundreds-of-interactive-earth-science-animations-and-investigations (Interactives and investigations) http://www.nature.com/scitable/knowledge/library/dating-rocks-and-fossils-using-geologic-methods-107924044 (Reading component about fossil and rock dating) http://phet.colorado.edu/en/simulation/radioactive-dating-game (Radioactive dating simulation) http://www.iris.edu/hq/files/programs/education_and_outreach/aotm/24/Stratigraphy_Handout.pdf (Cross Section student Sheet) http://tinyurl.com/lbf4leo "How Do Geologist Know How Old a Rock Is? article) https://www.youtube.com/watch?v=VLBzMvsiYq8 ("Stratigraphic Cross Section-Interpreting the Geology") https://www.youtube.com/watch?v=6lbJrvtxWNE (" Milankovitch Cycles") https://www.classzone.com/books/earth_science/terc/content/investigations/es2903/es2903page02.cfm (The Story in the Rock)	
Student Resources:	http://tinyurl.com/pvccezm (interactive for absolute dating) http://phet.colorado.edu/en/simulation/radioactive-dating-game (radio active dating simulation) http://www.softschools.com/quizzes/chemistry/half_life/quiz3544.html (chemistry quiz) https://www.sascurriculumpathways.com/portal/Launch?id=951 (virtual dating lab requires you to create a free account) http://fossils.valdosta.edu/home_time.html (superposition interactive) https://www.youtube.com/watch?v=VLBzMvsiYq8 ("Stratigraphic Cross Section-Interpreting the Geology") http://tinyurl.com/a5vfl6 ("Older than Dirt" Web Quest) http://education.usgs.gov/lessons/schoolyard/ages.html ("Ages of Rock")	
Assessment:	Students will be given geologic evidence and determine the order in which events happened, supporting their answer based on analysis of absolute and relative dating information. Their reasoning will be presented in a poster.	
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.	N/A

Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	Teacher may provide information about the Milankovitch Cycles to allow students to analyze glacial and interglacial periods. The teacher may discuss uniformitarianism.	N/A
Critical Content:	● The Law of Superposition ● Principal of Lateral Continuity ● Principal of Uniformitarianism ● Principle of Inclusion	
Key Skills:	● Identifying layers within a cross-section of Earth's layers.	
Critical Language:	Cross-cutting, carbon dating, radiometric dating, isotope, inclusions, intrusion	

Learning Experience # 7	
The teacher may introduce the concept of geologic columns using samples, videos, or photography so that students can interpret and analyze data from the fossil record to support claims that life and the environment on earth has changed over time.	
Generalization Connection(s):	Evidence is used to determine the order of events in geologic time. (SC.09-GR.7-S.3-GLE.2-EO.d)
Teacher Resources:	http://www.nps.gov/colm/learn/education/upload/Teachers-Guide_geology.pdf (geology lessons to include geologic columns) http://edu.environmentalatlas.ae/downloads/Worksheet_Geological_Time.pdf (Timeline puzzle activity laminate for reuse) https://teacherweb.com/MA/Abington/MrsPeruzzi/ATripThroughGeologicTime.ppt (A Trip Through Geologic Time Power Point) http://anthro.palomar.edu/time/default.htm (methods on fossil dating) http://tinyurl.com/lcbnq98 ("How Do You Stack Up-Geologic Column" pictures, labs activity, etc.,) http://tinyurl.com/l3tso32 ("10 Labs in Earth History and Geologic Time") http://education.usgs.gov/lessons/soil.pdf (What's in My Soil?" lab) https://www.youtube.com/watch?v=XaEyUwEAGqQ ("The Geologic Column" video) http://www.wasdarwinright.com/geologicalcolumn.htm (The Geologic Column-Was Darwin Right?)
Student Resources:	http://www.amnh.org/ology/features/layersoftime/ (Layers of Time Fossil Game) http://phet.colorado.edu/en/simulation/radioactive-dating-game (radio active dating simulation) http://foms.johnston.k12.nc.us/cms/One.aspx?portalId=3025912&pageId=4793936 (Relative dating interactive) https://www.youtube.com/watch?v=EadTLGMu3LI ("Law of Superposition" video) https://www.youtube.com/watch?v=z6DH8P5C9_Q ("Index Fossils" video) https://www.youtube.com/watch?v=fx3BqQ44zDE ("How to Date a Dead Organism" video) https://www.youtube.com/watch?v=cpnIxlDVmHw ("Radiometric Dating" video)
Assessment:	The student will create a short constructed response to explain (based on evidence from rock layers) how the geologic time scale is used to organize Earth's history. Concepts that should be included: ● Law of Superposition ● Index fossils ● Carbon and radiometric dating

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 paragraph discussing rock layers as they relate to geologic time.	The student may orally present their understanding of the above concepts.
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	N/A	The student may detail their comprehension of the above concepts via digital presentation (i.e. PowerPoint, Prezi, animated video)
Critical Content:	● The Law of Superposition ● Absolute and Relative Dating	
Key Skills:	● Interpret data to date fossilized remains ● Chronological sequencing of events/fossils	
Critical Language:	Geologic column, interpret, sequence	

Learning Experience # 8	
The teacher may allow for exploration of various fossils so that students can describe how fossils are formed and identify the different types of fossils.	
Generalization Connection(s):	Evidence is used to determine the order of events in geologic time.
Teacher Resources:	http://nature.nps.gov/geology/nationalfossilday/activities.cfm (includes multiple labs, activities, etc.) http://fossils.valdosta.edu/home_time.html (interactive on fossils) http://www.fossils-facts-and-finds.com/paleozoic_era.html (links for printable student sheets, activities, articles, and much more) http://www.nature.com/scitable/knowledge/library/dating-rocks-and-fossils-using-geologic-methods-107924044 (reading component) https://www.youtube.com/watch?v=S5tMRSvyjk4 (Bill Nye "Fossils") http://pubs.usgs.gov/gip/geotime/fossils.html (Index Fossils) http://tinyurl.com/m6j7bxd (images of fossils) http://www.bbc.co.uk/nature/fossils ("Prehistoric Life")
Student Resources:	http://fossils.valdosta.edu/home_time.html (interactive on fossils) http://museumvictoria.com.au/melbournemuseum/discoverycentre/600-million-years/ (click for videos, virtual, and other activities) http://www.amnh.org/ology/features/layersoftime/ (Layers of Time Fossil Game) http://nature.nps.gov/geology/nationalfossilday/activities.cfm (Multiple projects but for this scroll down to "Meet My Fossil") http://coloradogeologicalsurvey.org/education/free-stuff/ (Free Colorado maps and other Colorado geologic resources as well) http://pubs.usgs.gov/gip/geotime/fossils.html (Index Fossils) http://tinyurl.com/m6j7bxd (images of fossils) http://www.bbc.co.uk/nature/fossils ("Prehistoric Life")
Assessment:	Students will re-create three types of fossil formation using Play-Dough, the process by which each fossil was formed. Students will creatively present these as if they are exhibits in a museum. Choices include: ● Freezing

	● Dessication ● Entombment (amber or tar) ● Carbonization ● Permineralization (petrification) ● Mold and cast	
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 assign a method of fossil formation to each student.	The student may create fewer fossil models. The student may orally present their understanding of the formation of fossils. The student may present information via digital format, diorama or visual display (i.e. artwork).
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide additional raw materials so that students may create other fossil models (e.g. sand, ice/ freezer)	The students may model additional methods of fossil formation.
Critical Content:	● Formation of fossils	
Key Skills:	● Describe how fossils can form in different ways ● Identify different types of fossil ● Sequence the steps of fossils forming in rock ● Describe how scientists study fossils	
Critical Language:	Fossilization, petrification, mummification, amber, tar, entombment, decomposition, mold, cast, trace, true form, organism, fossil, mineral replacement	

Learning Experience # 9		
The teacher may lead a Socratic seminar discussing how the past is used to tell a story about the present so that students can model how fossil evidence contributes to understanding of life on Earth over time.		
Generalization Connection(s):	Evidence is used to determine the order of events in geologic time. Geologic time, observed in land formations and rock layers, indicate major change events in Earth's history	
Teacher Resources:	http://www.readwritethink.org/professional-development/strategy-guides/socratic-seminars-30600.html (strategy guide for Socratic seminars). http://www.medicaldaily.com/2050-human-evolution-may-regularly-reach-100-plus-life-spans-delayed-childbirth-304584 (optional Socratic prompt) https://www.youtube.com/watch?v=uQ91AxUqHck ("Planet Earth 100 Million Years Into The Future-What Will Happen To Our Earth" with human impact toward ending for optional Socratic prompt)	
Student Resources:	https://www.youtube.com/watch?v=GVJ8ILNzRKg (video: Socratic seminar basics for students)	
Assessment:	Students will construct a brief essay evaluating key questions discussed during the Socratic seminar and provide evidence supporting each key question.	
Differentiation: (Multiple means for students to access content and multiple	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	The teacher may provide questions to prompt thoughtful scientific answers.	The students may video themselves discussing the topics discussed during the seminar.

modes for student to express understanding.)		
Extensions for depth and complexity:	**Access** (Resources and/or Process)	**Expression** (Products and/or Performance)
	N/A	N/A
Critical Content:	● Fossil Formation ● Geologic Time Divisions ● Scientific Method	
Key Skills:	● Interpret fossil evidence ● Analyze data ● Defending a hypothesis using scientific data	
Critical Language:	Evidence, analyze, interpret, hypothesis, theory	