Interactive (Digital) Rock Cycle Activity
Aligned Lesson 2
Science Lesson for Unit: Rock Cycle Rocks

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Unit: Rock cycle Rocks	**Lesson Length:** 1-2 (45-minute) class period
Grade Level: 6-8; Piloted at Grade 6	**Related Unit:** • The Rock Cycle; Geologic Change • MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. (NGSS) • MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. (NGSS) • WHST.6-8.2 - Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (CCSS ELA) • RST.6-8.7 - Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (CCSS ELA) • SL.8.1 - Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (CCSS ELA) • SS.IS.6.6-8.MdC - Construct explanations using reasoning, correct sequence, examples and details, while acknowledging their strengths and weaknesses. (IL SS) •

Enduring Understandings	Essential Questions
• Models can be used to represent systems and their interactions. • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. • Rocks and fossils tell the history of Earth and how environmental conditions have changed over time. • The principle of uniformitarianism states that the processes that occurred in the past are the same as the processes occurring presently, and will continue to occur in the future. • The rock cycle is a slow, continuous, never-ending recycling of rocks that changes Earth's surface. • Energy from Earth's interior drives the rock cycle. • Weathering changes rocks on Earth's surface. • Erosion carries rocks away on Earth's surface. • Melting of rocks can occur on or below Earth's surface. • Igneous rocks can form aboveground from quick-cooling lava and underground from slow-cooling magma. • Sedimentary rocks are made from cemented and compacted sediments. • Metamorphic rocks are formed underground when a rock is exposed to intense heat and pressure. • All rocks can weather and erode. • All rocks can melt into magma. • Geologic change on Earth is sudden, the result of catastrophic events (catastrophism), or slow and gradual (uniformitarianism). • Geologic changes that occur today will affect resources and landscapes in the future.	• How does energy contribute to the formation of Earth materials, such as minerals, rocks, and ores? • How can scientists determine what has happened in the past? • How does energy affect Earth's landscapes? • How do processes in the Rock Cycle affect earth's landscapes? • How does change happen to Earth's landscapes? • Changing Earth: What has the history of Earth looked like?

Transfer Goals

- Developing and using models
- Constructing explanations (for science)
- Identifying Patterns and Causes/Effects to make future predictions
- Using data and evidence of past events to make statistical predictions for future events
- Citing evidence that stability may be disturbed by sudden events or gradual changes over time

Learning Objectives

- Use reasoning, along with the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, to connect

the evidence and support an explanation for how the geologic time scale is used to construct a timeline of the Earth's history.

- Use evidence and reasoning to construct an explanation for the given phenomenon, which involves changes at Earth's surface.
- Identify and describe* the evidence necessary for constructing an explanation, including:
    - The slow and large-scale motion of the Earth's plates and the results of that motion.
    - Surface weathering, erosion, movement, and the deposition of sediment ranging from large to microscopic scales (e.g., sediment consisting of boulders and microscopic grains of sand, raindrops dissolving microscopic amounts of minerals).
    - Rapid catastrophic events (e.g., earthquakes, volcanoes, meteor impacts).
- Identify the corresponding timescales for each identified geoscience process.
- Use multiple valid and reliable sources, which may include students' own investigations, evidence from data, and observations from conceptual models used to represent changes that occur on very large or small spatial and/or temporal scales (e.g., stream tables to illustrate erosion and deposition, maps and models to show the motion of tectonic plates).
- Use reasoning, along with the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, to connect the evidence and support an explanation for how geoscience processes have changed the Earth's surface at a variety of temporal and spatial scales.
- Use reasoning, along with the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, to connect the evidence and support an explanation for how geoscience processes have changed the Earth's surface at a variety of temporal and spatial scales. Students describe the following chain of reasoning for their explanation:
    - Surface processes such as erosion, movement, weathering, and the deposition of sediment can modify surface features, such as mountains, or create new features, such as canyons. These processes can occur at spatial scales ranging from large to microscopic over time periods ranging from years to hundreds of millions of years.
    - Catastrophic changes can modify or create surface features over a very short period of time compared to other geoscience processes, and the results of those catastrophic changes are subject to further changes over time by processes that act on longer time scales (e.g., erosion of a meteor crater).
    - A given surface feature is the result of a broad range of geoscience processes occurring at different temporal and spatial scales.
    - Surface features will continue to change in the future as geoscience processes continue to occur.

Students will be able to:

- Explain the changes that happened in Earth's 4.6 billion-year past are the same changes that occur in the present and will continue to occur in the future.
- Identify weathering as the force that breaks rocks down.
- Identify erosion as the force that move rocks from one place to another.
- Identify weathering and erosion as forces that work together to make and move sediment from one place to another.
- Identify compaction and cementation of sediments as the forces that create Sedimentary Rocks.
- Identify heat and pressure as the agents of metamorphism (Metamorphic Rocks.)
- Identify the cooling and hardening of magma and lava as the forces that create Igneous Rocks.
- Point to melting as the cause of any rock turning back into magma under the Earth's surface, or lava above.

- Identify Earth's internal energy as the driving force for the Rock Cycle.
- Identify the sun, water, and wind as agents of weathering and erosion on Earth's surface.
- Classify the Rock Cycle as a slow and gradual process but identify counterexamples to explain when rocks can be changed suddenly, as seen in natural disasters.
- Explain the Rock Cycle and its processes verbally or in text.

Library of Congress: Primary Sources	**Materials/Supplies/Resources**
Devils Tower • https://www.loc.gov/item/2015634202/ 	• *Rock Cycle Vocab Guided Notes* (distributed in previous class period.)* * Template for Guided Notes created by and downloaded from Liz LaRosa www.middleschoolscience.com • Computer with Internet Access for LOC & WebQuest • https://www.learner.org/interactives/rockcycle/ • WebQuest Guided Worksheet - designed by Tracy Tomm of The Science Spot - http://sciencespot.net/Pages/classearth.html#Anchorsed

Lesson Plan

Engage: How can I get students interested in this?

- See attached Lesson Plan & WebQuest Guided Worksheet for detailed plans.
- Teacher will begin class where it ended yesterday – Students will sing "The Rock Cycle Song."
- Teacher will engage students with historical tie-in to Devils Tower, Wyoming.
- Teacher will attempt to have students identify evidence for the Rock Cycle in the photo of Devils Tower via completion of the LOC Primary Analysis Tool. See http://www.sylvanrocks.com/devils_tower_climbing/legends_history & http://www.sylvanrocks.com/devils_tower_climbing/geology_formed for more information about Devils Tower. Students may have visited the geographic location in person. The site was also featured in Close Encounters of the Third Kind (PG). Allow students to share their responses and experiences with seeing this feature.
- Students will complete a guided and grade-appropriate online interactive that teaches students the new concepts and assesses their understanding. The interactive offers digital games and animations that students manipulate at their own pace. Digital activities tend to interest students, but teachers must make sure that students are attending to the tasks associated with the activity.

Explore: What tasks/questions can I offer to help students puzzle through this?

- See attached lesson for detailed plans.
- Yesterday, the teacher utilized whiteboards and NOTES templates to help students gain understanding of significant ideas and terms. Today, students will use those NOTES to make sense of what they see at Devils Tower and in the online interactive.
- Students will explore the animations and assessments at Learner.org and Study Jams independently.
- It is imperative that the teacher circulates and checks for student understanding while answering the questions. Equally critical, the teacher has to identify those students who appear to be struggling with the concepts.

Explain: How can I help students make sense of their observations?

- See attached lesson for detailed plans.
- From the very beginning, students are using their new knowledge and NOTES to make and explain observations on the Rock Cycle at Devils Tower in Wyoming.
- The *WebQuest Guided Worksheet* was written in a way to create understanding within the procedure. So, as the students answer questions, they then make sense of what the task is and how it fits in the Rock Cycle.
- Animations help make sense of new and challenging content. Animations can be replayed infinitely.
- Upon answering the questions, students are given multiple formative assessments to help clarify material.
- The teacher can also help with mnemonic devices as the students work, such as "MMMMMMelting MMMMMMakes MMMMMagma." This helps students.
- THE TEACHER MUST CHECK FOR UNDERSTANDING AND CLARIFY MISCONCEPTIONS AS THEY ARISE.

Extend/Elaborate: How can my students apply their new knowledge to other situations?

- See attached lesson for detailed plans.
- This activity should segue into a discussion on Earth's history, as the presence of Igneous and Metamorphic Rocks give us a glimpse into how the areas have changed over time. Ex – The presence of Granite indicates volcanic activity that is believed to have occurred underground.
- Students should begin to realize that the rock cycle occurs around them every day aboveground and underground – Pebbles are evidence of weathering; cars transporting rocks stuck in tires show erosion.

Evaluate: How can I help my students self-evaluate and reflect on the learning?

- See attached lesson for detailed plans.
- Students begin to make claims and cite evidence for the Rock Cycle as seen in Devils Tower. The teacher guides the discussion and allows for students to relate Devils Tower to the Rock Cycle.
- Students explore the Learner.org site. This site has built-in assessments.
- With additional space on the WebQuest Guided Questions, the teacher could have students write a brief summary on what they learned that they didn't know before or complete a sample 3-2-1 Exit Ticket.
- For students who struggle on the assessments, they could identify where they are confused, or what tricked them on the assessments.

Unit 2 – Lesson 2

1-2 Class Periods (45 minutes each)

Interactive (Digital) Rock Cycle Activity

Julie M. Senka

This activity was used in my class to further a deeper understanding of the processes that shape Earth's landscapes. It is standards-based and allows students to learn concepts, practice essential vocabulary, and reflect on their interactive experiences. On Days 1-2, the topic and Key Vocabulary were introduced. For this activity, engagement, electronic interaction, and exploration are encouraged leading up to the next lesson, which is a true hands-on opportunity.

SEP	Using a (digital) model to demonstrate phenomena Ask Questions – Why are rocks different? How do rocks change? How are rocks made? Analyze and Interpret Data – Why do rocks look the way they do? Constructing explanations Obtaining, evaluating, and communicating information.
BIG IDEAS/DCI	Earth's features are the result of geological processes. Change on Earth is generally slow but can occur due to sudden events. There are 3 different types of rocks. Rocks form in different ways, and their appearances give us clues to their histories and what made them. The same changes that happened in the past will happen in the future.
CCC	Stability and Change – Identify factors that disrupt stability and lead to change over time. Cause and Effect – An external (force) cause produces a predictable effect in rocks. Structure and Function – Features of rocks determine their uses. Energy & Matter – Rocks are changed due to the cycling of energy in the rock cycle. Scale Proportion & Quantity – Digital model is too small to represent the depth of the Rock Cycle.
Misconceptions	Rocks are the same and come from the same places. Rocks are distributed evenly throughout the world. Metamorphic rocks are made from magma. Rocks are boring and tell us nothing about Earth. Change only occurs slowly.

Day 1 –
Part 1 – 15 minutes

- Students should sing, "The Rock Cycle Song."
- The teacher should display the LOC image of Devils Tower on a Smart Board or through students' computers.
- Students should complete the LOC Primary Analysis Tool and discuss the questions.
    - How does this picture of Devils Tower in Wyoming show the Rock Cycle?
    - Possible Answers include, but are not limited to:
        - The Tower has been worn away
        - The Tower is flat from wind/water.
        - Tree roots break down rocks.
        - Weathering and Erosion due to pond/water.
        - Scratches in the Tower's side from abrasion.
        - Weathering due to acid rain? (Unlikely here, but kids like to reference this.)
        - Underground volcanic activity – Igneous Rock Formation
        - Some force pushed Devils Tower up from underground.

OPTIONAL PART 2 – 10 minutes

- Optional Modification – The teacher can show Devils Tower from the movie "Close Encounters of the Third Kind." Combined with a reading of the history of Devils Tower and

how it is depicted in the movie, a discussion can follow on how different cultures viewed the landmark.
    - Native Americans used it as a worshipping ground and continue to hold religious ceremonies there during the month of June, when it is voluntarily closed to hikers. Upon meeting "white men," the name was mistranslated to Bad God Tower, and then to Devil's Tower. A grammatical error that left out the apostrophe changed the name of the landmark.
    - The movie depicts Devils Tower as an extraterrestrial landmark that seems to have its own powers.
    - Science says it was created by magma underground and over time, exposed due to weathering and erosion.

Part 3 – WebQuest – 25 minutes of Day 1 & 25 minutes of Day 2

- The WebQuest that follows was created by Tracy Tomm at the Sciencespot.net - https://sciencespot.net/Media/riderockcycle2016.pdf
- Distribute the Rock Cycle WebQuest Guided Questions Worksheet to students. The teacher should use trackstar.4teachers.org or share the links on Google Classroom to help students with finding the site.
- Students follow the directions on the WebQuest to view the Interactive Rock Cycle at Learner.org. When students move the mouse over the processes, an animation and description pop up.
- Students should complete all questions on the worksheet. Context clues are given for rock identification. Encourage students to look at Notes from the previous class to solidify understanding.
- It is imperative that the teacher circulates and checks for student understanding while answering the questions. Equally critical, the teacher has to identify those students who appear to be struggling with the concepts.
- This counts as a formative assessment, and the teacher should check for understanding. If there are global trends, the teacher should address those at the start of class the next day.
- It is recommended that students complete this independently, so the teacher can get an accurate idea as to levels of understanding.
- Upon completion, students can:
    - Draw an independent rock cycle
    - Write a paragraph that outlines three things they learned.
    - Complete a 3-2-1 Exit Ticket (sample attached).

Differentiation Strategies –
For students who struggle -

- For students who struggle, this activity can be read to students through the computer.
- Mnemonic devices – MMMMMelting mmmmmakes mmmmagma may be beneficial.
- Hints such as Ign…IGNite – IGNeous – are made from fire…What is the fiery stuff called?
- Another beneficial hint is to use: SEDIMENTary is made from SEDIMENT.
- Breaking down the Latin roots for Igneous and Metamorphic may help students.
- Discuss answers to Site 1 as "Guided Practice" before having students move on to independently answering questions from Site 2.

For students edging toward Mastery –

- Create a shareable T-chart or Venn Diagram that identifies key characteristics and processes for the three types of rocks.
- Students could create Exit Tickets (with an answer key and explanation) that could be utilized in class.
- Students can pair up with a student who is struggling to reinforce concepts.

Assessment – Options for assessment include:

- Grading items line by line. Total points = 35
- Recommended Assessment – The teacher should pay attention to the following questions:
    - Site 1 – Questions 1-3, which cover the processes and types of rock.
    - Site 2 – Questions 1-4, which identified the types of rocks with respect to their major characteristics.
    - Site 2 – Question 6, which summarizes the rock cycle.
- A rubric with sample remediation plan has been included.

Rubric –

Criterion – I Can	Mastery - 3	Getting There - 2	Needs Clarification - 1
Site 1 – 1-3 – Identify the types of rock based on the processes that create the rocks.	Correctly identifies all three types of rock and the processes that create them.	Correctly identifies two types of rock and the processes that create them.	Correctly identifies one type of rock and the processes that create it.
Site 2 – 1-4 – Identify the major characteristics of rocks	Correctly identifies major characteristics of the 6 example rocks.	Correctly identifies major characteristics of 4 or 5 of the 6 example rocks.	Correctly identifies major characteristics of 1, 2, or 3 of the 6 example rocks.
Site 2 – 1-4 – Identify the rock type based on its major characteristics	Correctly uses major characteristics of the 6 example rocks to correctly name the type of rock in all 6 examples.	Correctly uses major characteristics of the 6 example rocks to correctly name the type of rock in 4 or 5 of the 6 examples.	Correctly uses major characteristics of the 6 example rocks to correctly name the type of rock in 1, 2, or 3 of the 6 examples.
Site 2 – Question 6	Identifies all 3 processes that form the three different types of rocks.	Identifies 2 of 3 processes that form the three different types of rocks.	Identifies 1 of 3 processes that form the three different types of rocks.

Sample Remediation – Students can opt for additional interactive help, complete the feedback box, and return the attached slip to the teacher. A student can also choose to receive one-one help with the teacher during a study hall or advisory.

Student Name _____

Area that needs clarification? (Teacher will check)	How can this be clarified? (student will decide)	Student feedback after receiving help
Igneous Rocks	_____ Brainpop Video _____ Study Jams Video _____ Classzone Animation _____ Quizlet Game _____ Quia.com review _____ Other (specify)	
Sedimentary Rocks	_____ Brainpop Video _____ Study Jams Video _____ Classzone Animation _____ Quizlet Game _____ Quia.com review _____ Other (specify)	
Metamorphic Rocks	_____ Brainpop Video _____ Study Jams Video _____ Classzone Animation _____ Quizlet Game _____ Quia.com review _____ Other (specify)	

Sample exit ticket – from
http://i.pinimg.com/736x/a6/67/df/a667dfcc6ae79d085f734c0f81b07022.jpg

Name: _____

Three new facts I learned...		
1.	2.	3.
Two ah-ha's that popped into my mind		
1.	2.	
One big question that I still have:		
1.		