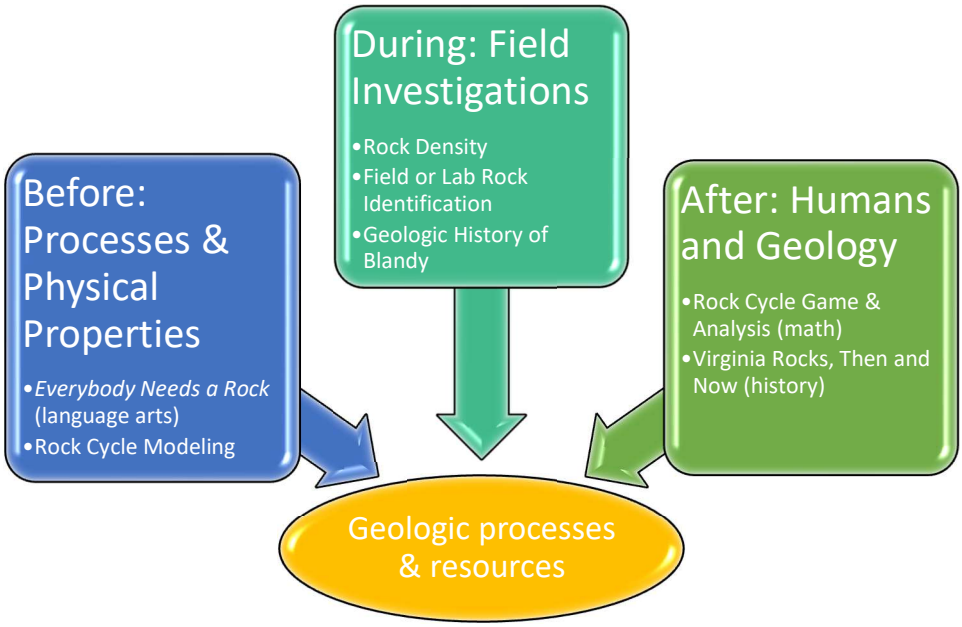


Your students will be visiting Blandy to engage in a field investigation focused on geologic systems.

To enhance classroom connections, we have developed this lesson cluster. Field investigations are more meaningful to students when they are integrated into their curriculum. This lesson cluster can be used to introduce and/or review geology and human uses of geologic resources and increase depth of concepts and knowledge of these processes. Before-visit activities use modeling and language arts to develop student familiarity with geologic processes, properties, and observation skills. With the after-visit activities, students synthesize data and concepts learned /gathered in the field and connect Virginia geologic resources with human history.

BEFORE 1: *Everybody Needs a Rock*

Before your visit to introduce students to the process of making close observations of rocks and to the vocabulary of rock identification.

VA Standards Addressed: English/Language Arts 5.1, 5.5, 5.6, 5.7, 5.8 Science (2018) 5.8

Materials

- *Everybody Needs a Rock* by Byrd Baylor (Available from bookshop.org or on Amazon Kindle) **OR**
- *A Rock is Lively* by Dianna Hutts Aston, illustrated by Sylvia Long (available in from bookshop.org ebook, hardback, and paperback online, or in hardback through Handley Regional Library System)
- One egg carton per student
- Label materials
- Optional: tools to measure a rock (scale, ruler, caliper, etc.)

Lesson Preparation

1. Obtain as many copies of your chosen text as necessary (one per student for independent reading – one if reading as a class). We recommend having both books on hand for student choice.
2. At least a week in advance, send home a note to guardians asking for egg carton donations and informing them that students will be collecting a dozen special rocks over the course of a week. Encourage guardians to help student select carefully and in a variety of locations.

Instructional Strategy

1. Do a first read of your chosen text with the class:
    a. *Everybody Needs a Rock* (ENR) is a narrative non-rhyming poem describing the "ten rules" to use when selecting a rock and fits a variety of English/language arts units and reading methods. The focus is on using senses and emotion to carefully choose a rock.
    b. *A Rock is Lively* (ARL) is a beautiful non-fiction alternative, however the text may be inaccessible to some students. The focus is on geologic processes, rock composition and use.
2. Instruct students to find a dozen "great rocks" to fill their egg carton. We recommend allowing a full week (including a weekend) for students to find the dozen special rocks.
    a. If using ENR, students should use the ten rules described in the poem.
    b. If using ARL, students should simple think about what makes the rocks they chose special.
3. Conduct a second reading of ENR or ARL, this time focusing on the *physical properties* described in the text. Ask students to list as many physical properties (color, texture, smell…) that they can remember from the text and compile in a class list. Ask if anyone can think of other physical properties not in the text and add it to the list. To learn more about the physical properties used to identify rocks and minerals, visit http://core.ecu.edu/geology/woods/MineralPropertiesExplain.htm
4. Have students select their "best rock" for their collection and describe it in written word. This can take the form of prose or poetry and can be subject to an editing process. Focus on physical characteristics/using all senses/measuring and quantitative/emotional/imaginative descriptions. Modeling this process may help students access deeper reflection and observation.

5. Display the completed description in the lid of the egg carton and challenge other students to identify the correct rock based on the description.
6. Conclusion: Discuss what kinds of descriptions helped the most in identifying a rock (physical properties and observable features) and which descriptions made the rock most interesting (possibly observable features or personal connections). What kinds of professions focus on observable features (science fields, construction, agriculture…) and which focus on personal connections (artists, writers, musicians)? Note that most professionals use both kinds of descriptions, even if they focus on one.

Specials Extension

Art collaboration: Students swap descriptions (keeping the original rock hidden) and create a visual representation of the rock described in writing using a medium of the art instructor's choice. They then compare the artistic rendering of the rock to the actual sample, and use any discrepancies to help edit the descriptive writing.

BEFORE 2: Rock Cycle Modeling

Before your visit to Blandy, this activity introduces the concept of the rock cycle and practices the process of modeling. Different colors of crayon shavings or chocolate chips represent different minerals combining to form rocks through various processes in the rock cycle. The same procedure can be used for crayon shavings or chocolate chips. It takes more time to "weather" the crayons than it does the chocolate, however chocolate may not be permitted in your educational setting.

VA Standards Addressed: Science (2018) 5.1, 5.8

SAFETY: Use caution and adult supervision if utilizing a hot water bath to melt materials.

Materials:

Crayon Rock Cycle	Chocolate rock Cycle
• 3 wrapper-less crayons OR peeled crayons of different colors for each pair • Hand-held pencil sharpener for each pair • Sheet of aluminum foil for each pair • Paper plate for each pair • Dedicated ice cube tray • Access to a microwave • One copy of ModelingRockCycleCrayon packet per pair	• Three different types of baking morsels (brown & white chocolate, butterscotch) • Plastic knife for each pair • Sheet of aluminum foil for each pair • Paper plate for each pair • Dedicated ice cube tray • Access to a microwave • One copy of ModelingRockCycleChocolate packet per pair

Instructional Strategy: Full instructions are included in the Modeling Rock Cycle packets.

1. Determine degree of teacher leading and grouping strategy. Will the entire class do each step simultaneously (not recommended unless necessary), will pairs work independently, or will pairs work in multiples to form small groupings?
2. Have students read through the ModelingRockCycleCrayon packet's introductory paragraph explaining the rock cycle. A short discussion of that paragraph may help to extract understanding.
3. Ask students what it means to "model the rock cycle" and why they are modeling it instead of observing it directly. Have them describe some other models as prompts.
4. Students obtain materials and construct the models. Move among partners to help with direction following and to ask clarifying questions.
    a. Some steps require timing. Student pairs can use a stopwatch, the classroom clock, or counts of "Mississippi". (this is an opportunity to practice measuring or estimating elapsed time.)
    b. Heating process: if a microwave is not available, VERY HOT water baths can be used. Students form foil "boats" and float their metamorphic "rock" until a magma-like state is obtained.
    c. During the heating process, the magma may need to be stirred, simulating convection.
    d. The end product of both versions is a single block of crayon or candy. We recommend using the crayon ends that couldn't be sharpened to create a second block crayon so both partner have an igneous crayon rock. The chocolate rock can be cut into pieces by an adult and shared.

5. The questions and diagram at the end of the packet can be collected and used for partner assessment, can be printed for each student, collected and used as individual assessment, or reviewed as a class and used later as a resource.

Formative Assessment Options

- Prior to the modeling experience, have students write their name on and then draw a rock cycle diagram on the top half side of a piece of paper folded in two. Collect these and evaluate to determine areas of misconception and areas of knowledge.
- After completing the modeling experience (the next day or later), re-distribute the papers and have students draw a new rock cycle diagram on the bottom half. Collect and evaluate for growth, demonstration of understanding, and areas of remaining misconception.
- A third diagram can be completed after playing the Rock Cycle Game either at Blandy or at school following your field experience.
- To reduce the test-like feel of this assessment, in all but the final diagramming allow students to work with a partner. This allows them the opportunity to share information to build their understanding, still reveals lingering misconceptions, and makes the experience more pleasant.

Culinary Geologist Names_____Date_____

Modeling a Rock Cycle

The rock cycle is a never-ending process. Igneous rock forms from cooled magma or lava. Weathering breaks rocks into sediments such as pebbles and sand. These small pieces can be compacted and cemented under pressure into sedimentary rock. Under great heat and pressure inside the Earth's crust, igneous and sedimentary rocks are changed into metamorphic rocks. These rocks are pushed to the Earth's surface where they are weathered again into sediments to become sedimentary rocks or pushed into the mantle where they melt into magma.

Materials

3 peeled crayons (different colors)	sheet of aluminum foil	heavy books
Hand held pencil sharpener	paper plate	ice cube tray (to share)
	timer	microwave (adult use)

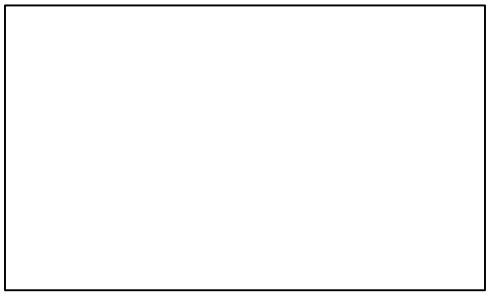
Safety: The hot materials can cause burns. Be careful.

Part 1 Weathering Rocks Procedure

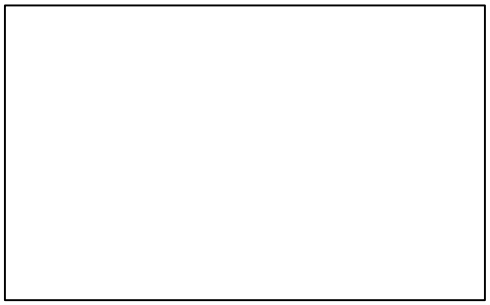
A. Use the pencil sharpener to turn one crayon into shavings. Set the end of the crayon aside.
B. Pour the little pieces and shavings on to the aluminum foil.
C. Take another color and sharpen into shavings.
D. Pour the little pieces and shavings on top of the other color on the foil.
E. Repeat with the last color.

1. Describe your observations.

2. Draw and color what you see from the top.



3. Draw and color what you see from the side.



Part 2 Making Sedimentary Rock Procedure

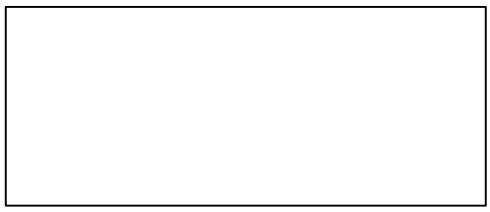
A. Fold the aluminum foil over your three layers of shavings.

B. Place two or three heavy books over the aluminum foil and leave for 3 minutes.

C. Take off the books and observe the shavings.

4. Describe your observations.

5. Draw and color what you see from the top.



6. Draw and color what you see from the side.

Part 3 Making Metamorphic Rock Procedure

A. Fold the aluminum foil over the shavings again.
B. Press very hard on the foil with your hands for 30 seconds, pass to your partner.
C. Your partner does the same for another 30 seconds.
D. Continue doing this until both partners have done it 4 times.
E. Unwrap the aluminum foil and observe the shavings.

7. Describe your observations.

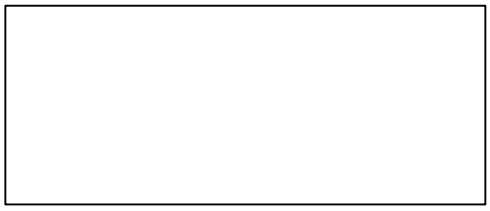
_____

_____

_____

8. Draw and color what you see from the top.

9. Draw and color what you see from the side.



Part 4 Making Igneous Rock Procedure

A. Place your crayon "metamorphic rock" in an ice cube tray.

B. Your teacher will microwave the full tray in 30 second intervals until a magma state is reached. (In the real rock cycle, the pressure and heat of the inside of the earth would do this over millions of years.)

C. Do not touch the tray for at least **10 minutes** (work on questions 13 – 20 while you wait)**.**

D. Your teacher will give you your crayon "rock" for observation.

10. Describe your observations.

11. Draw and color what you see from the top.

12. Draw and color what you see from the side.

Questions

13. What did your group do to model weathering rocks?

14. What did your group do to make the sedimentary rocks stick together?

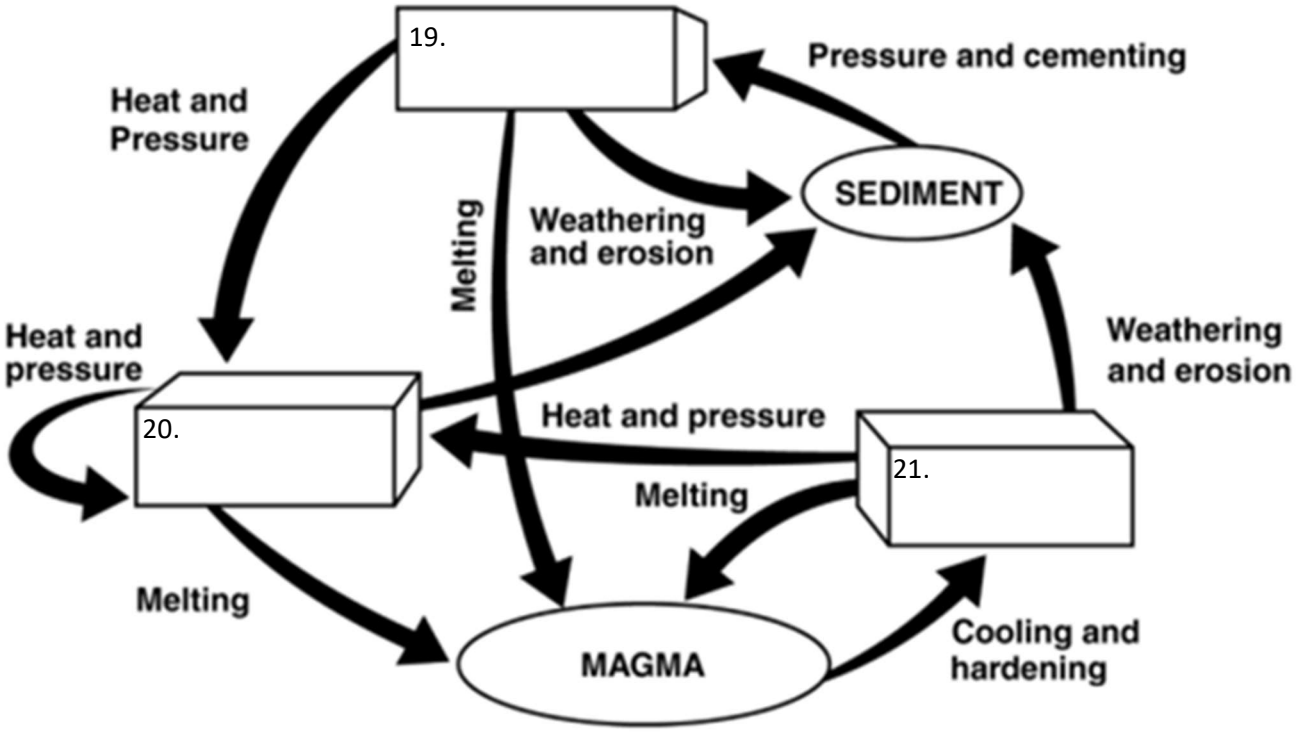
15. What did your group do to make the metamorphic rocks stick together?

16. What was the difference between what you did to make sedimentary rocks and what you did to make metamorphic rocks?

17. What did your group do to make the igneous rocks?

18. What was different between what you did to make metamorphic rocks and to make igneous rocks?

Fill in the diagram with: **Sedimentary Rocks, Metamorphic Rocks, and Igneous Rocks**



Culinary Geologist Names_____Date_____

Modeling a Rock Cycle- Chocolate

The rock cycle is a never-ending process. Igneous rock forms from cooled magma or lava. Weathering breaks rocks into sediments such as pebbles and sand. These small pieces can be compacted and cemented under pressure into sedimentary rock. Under great heat and pressure inside the Earth's crust, igneous and sedimentary rocks are changed into metamorphic rocks. These rocks are pushed to the Earth's surface where they are weathered again into sediments to become sedimentary rocks or pushed into the mantle where they melt into magma.

Materials

10 chocolate chips	plastic knife	heavy books
10 white chocolate chips	sheet of aluminum foil	ice cube tray (to share)
10 butterscotch chips	paper plate	microwave (adult use)
	timer	

Safety: The hot materials can cause burns. Be careful.

Part 1 Weathering Rocks Procedure

F. Pour one color of chips on the plate and cut them into little pieces and shavings with the plastic knife. (The smaller the pieces and shavings, the better)

G. Pour the little pieces and shavings on to the aluminum foil.

H. Take another color of chips and cut them up into little pieces.

I. Pour the little pieces and shavings on top of the other color on the foil.

J. Repeat with the last color.

3. Describe your observations.

4. Draw and color what you see from the top.

3. Draw and color what you see from the side.

Part 2 Making Sedimentary Rock Procedure

A. Fold the aluminum foil over your three layers of chips.

B. Place two or three heavy books over the aluminum foil and leave for 3 minutes.

C. Take off the books and observe the chips.

6. Describe your observations.

7. Draw and color what you see from the top.

6. Draw and color what you see from the side.

Part 3 Making Metamorphic Rock Procedure

A. Fold the aluminum foil over the chips again.
B. Press very hard on the foil with your hands for 30 seconds, pass to your partner.
C. Your partner does the same for another 30 seconds.
D. Continue doing this until both partners have done it 4 times.
E. Unwrap the aluminum foil and observe the chips.

9. Describe your observations.

10. Draw and color what you see from the top. 9. Draw and color what you see from the side.

Part 4 Making Igneous Rock Procedure

A. Place your chocolate "metamorphic rock" in an ice cube tray space.

B. Your teacher will microwave the full tray in 30 second intervals until a magma state is reached. (In the real rock cycle, the pressure and heat of the inside of the earth would do this over millions of years.)

C. Do not touch the tray for at least **10 minutes** (work on questions 13 – 20 while you wait)**.**

D. Your teacher will give you your chocolate "rock" for observation.

12. Describe your observations.

13. Draw and color what you see from the top.

12. Draw and color what you see from the side.

Rocks Talk

Questions

19. What did your group do to model weathering rocks?

_____

20. What did your group do to make the sedimentary rocks stick together?

_____

21. What did your group do to make the metamorphic rocks stick together?

_____

22. What was the difference between what you did to make sedimentary rocks and what you did to make metamorphic rocks?

_____

23. What did your group do to make the igneous rocks?

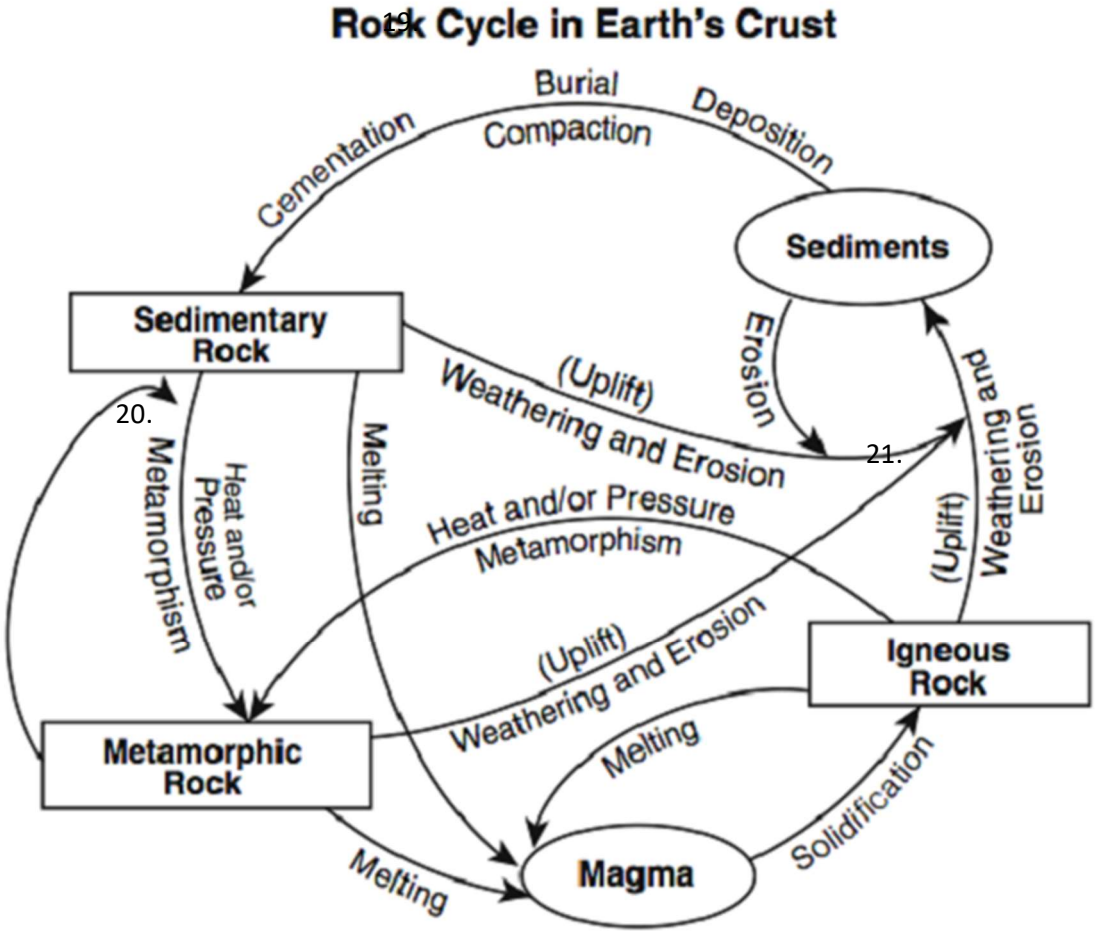
_____

24. What was different about what you did to make metamorphic rocks and to make igneous rocks?

_____

Fill in the diagram with: **Sedimentary Rocks, Metamorphic Rocks, and Igneous Rocks**

Rocks Talk



https://www.printablediagram.com/the-rock-cycle-diagrams-to-print/the-rock-cycle-diagram-earth/

DURING: Field Investigation

During your field investigation at Blandy, your students will engage in several indoor and outdoor lessons where they explore geology concepts as field and laboratory geologists, landscape historians.

Below is an overview of the "standard" program activities to assist you with integrating this field experience into the classroom experiences. This will change due to weather, volume of students or communication with environmental educators.

VA Standards Addressed: Science (2018) 5.1, 5.8. Math (2016) 5.5b, 5.8a, 5.9b. Social Studies**:** VS.2, USI.2d

- **Field or Laboratory Rock Identification:** In small research groups, students, as field geologists, identify the native rock at Lake Georgette and compare its properties to other rocks in their kit. If the weather is prohibitive, students as laboratory geologists identify and compare the properties of up to eleven rock samples in one of our indoor spaces. They communicate their findings and use evidence and reasoning to support their conclusions.
- **Rock Density Experiment:** Research geologists describe rock samples then calculate the volume of rock samples using displacement, measure the samples mass, and calculate the density of that rock type. They use this qualitative and quantitative information to identify their sample, compare it to the lab's research collection, and use a geologic map to identify in which Virginia geographic region it can be found.
- **Geologic History of Blandy**: As landscape historians, students learn to read Blandy's geologic history by examining its native rock and rocks imported to the grounds for human use. This examination uncovers ancient and ongoing geologic processes including tectonic plate collision and the resulting orogeny/subduction, as well as chemical and physical weathering.
- **Rock Cycle Game**- Students engage in a kinesthetic cycle game to model the geologic processes such as weathering, erosion and plate tectonics and how these factors affect the ever-changing earth.

AFTER 1: Rock Cycle Game & Analysis

For groups of four or more classes, the rock cycle game is conducted at Blandy. Smaller groups are welcome to use this kinesthetic modeling of the rock cycle at their school. If data are recorded during the game, mathematical analysis of those data provide students with a glimpse of the magnitude of geologic time. For the full lesson plan, including printable game materials and datasheets, please visit the Blandy Education website: https://www2.virginia.edu/blandy/blandy_web/education/CCEF2016-2017/RockCycle&Analysis_WEB.pdf

VA Standards Addressed: Mathematics (2016) 5.2, 5.5 Science (2018) 5.8

Materials

- Data sheets from the Rock Cycle Game
- Rock Cycle Game Data Analysis Sheet (one per student)
- Pencils (one per student)

Instructional Strategy:

1. Inform students they will use the Rock Cycle Data Analysis sheet and their group's journey to analyze and consider their rock cycle. As necessary, guide students through the tasks on the datasheet: factoring, calculating and simplifying fractions, converting fractions into decimals, double checking work.
2. Students then use the circle/pie chart on the back of the datasheet to display the number of stops made at each station. This is an excellent opportunity to assess student understanding of data display and graph making.
3. As a class, compare each group's results. *Ask*: Did each group have the same array of fractions? Explain why or why not. Discuss how long it takes rocks to transition from one type to another.
4. *Explore*: Ask groups to share their pie charts and discuss the display features they used. All options students used are probably correct; however, some methods may communicate the data better (easier for a reader to interpret the data). Have students discuss the importance of graphs for communication and assess which methods are better. Be sure to guide the discussion to focus on the METHODS, rather than on the students that did the work.

AFTER 2: Virginia Rocks, Then and Now: Geologic Resources of Virginia.

As mining and geological historians, students research, map, and compare rock and mineral resources of Virginia during the Civil War and present day.

VA Standards Addressed: History/Social Science VS.1b, g & j, VS.7, VS.8c, VS.10b, USI.1g & j, USI.2d, USI.9a & e Language Arts 5.2, 5.4, 5.6, 5.9 Science (2018) 5.8

Rocks Talk

Materials

- Tablet, computer, or other internet capable device for research (resources can be printed if necessary)
- A large map of Virginia OR a T-chart to compare past and present.
- Assorted materials for creating an informational display – either electronically or by hand

Instructional Strategy

1. Brainstorm with students: What are ways that rock and mineral resources are used by humans? Ask them to reflect on their own experiences as well as the Rock Density activity and Geologic History of Blandy walk from their field investigation. Do they think that rock and mineral resources are used today in the same way around the time of the Civil War? Where do they think the rock and mineral resources we use in our everyday lives come from?
2. Using the Virginia Department of Mines, Minerals, and Energy website, have students investigate the five pages that showcase the mineral resources used during the American Civil War, https://www.dmme.virginia.gov/dgmr/civilwar.shtml as well as the 21 mineral resources https://www.dmme.virginia.gov/dgmr/mineralreso.shtml and coal https://www.dmme.virginia.gov/dgmr/energyreso.shtml extracted in Virginia today.
    a. The five Civil War mineral resource pages go into great historical depth, while the modern resource pages focus on the geology and economics of the resource. We recommend dividing your class into five groups and assigning each group one historic resource and up to four modern resources (be sure to include coal, lead, and iron as they are the only resources that are extracted both historically and currently in Virginia).
    b. Resource pages contain terminology and concepts that may exceed the comprehension of the students. This is an excellent opportunity to practice reading for a purpose, and targeting their reading to extract specific information.
    c. Research can be open-ended or guided by the **Virginia Rocks, Then and Now Research Guide document**. If research is guided, instruct students to read through the entire resource page FIRST, using context clues to get an idea of the information on the page. Remind them "*Don't worry if you don't understand it all, geologic terms can be tricky!*" After one read through, distribute the research guide.
3. When students have concluded their research, they will create an informative label for the resources they investigated and place it on the T-chart or map in the proper location (some resources have multiple points of extraction. In that case the label can be placed on the side and lines drawn or strings taped to the map to show multiple locations).
4. Have each student group present their Civil War resources, including information on how that resource influenced the lives of people and the outcome of the war. Discuss: how has resource use in Virginia changed since the time of the Civil War?

Rocks Talk

Additional resources:
http://essentialcivilwarcurriculum.com/arming-the-confederacy-virginias-mineral-resources.html
https://www.dmme.virginia.gov/dgmr/economicreso.shtml (geographic provinces & relevant materials)

EXTENSION NOTE: In depth investigation of the Salt Works in Saltville, Va (including the two battles of Saltville and the historically debated "Saltville Massacre") is an excellent investigation for VS.7&8, and USI.9 (https://www.battlefields.org/learn/civil-war/battles/saltville and https://civilwar.vt.edu/saltville/).

Rocks Talk

Names: _____

Virginia Rocks, Then and Now Research Guide

Read through the guide below. Use it to focus your research as you RE-READ the Virginia Department of Mines, Minerals, and Energy resource page. Record your answers in the spaces provided. *Not all resource pages have all of this information. Read carefully, but don't worry if you can't find an answer.*

Name of resource: _____

What is this resource used for? _____

_____

First year it was produced or found in Virginia:		**Last** year it was produced or found in Virginia:	

*If still found or produced in Virginia, put the current year.

Describe the geologic process that formed the resource: _____

_____

Describe the historic significance (if any) of this resource: _____

_____

_____

What else is interesting or surprising about this resource: _____

_____

Rocks Talk

Mark on the map the location(s) at which your mineral or rock is/was found: