Rocks Makin' Rocks: Rock Cycle Simulation

Based on **NY Regents Earth Science: Rock Cycle Activity,** accessed Summer 2003, no longer available online.

Focus on Inquiry

The student will collect data the journey of a mineral through the rock cycle.

Lesson Overview

Students will participate in a simulation of the rock cycle. Collecting data by throwing die, students will develop an understanding of the movement of atoms and rock particles through the rock cycle.

Duration	Setting	Grouping	PTI Inquiry Subskills
45 minutes	Classroom	individually or in pairs	3.1, 3.7, 4.3, 5.9, 7.2, 7.3

Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	5 min	4.2, 5.8, 7.3	none	1	Begin by recalling prior knowledge of the rock cycle by drawing what they remember.
Explore	20 min	1.3, 3.1, 3.5, 3.7, 4.3, 5.3, 5.8	countdown timer app	3	Students collect data about their journey through the rock cycle stations.
Explain	10 min	3.6, 4.3, 5.2, 5.3, 5.8, 5.9	none	2	Students answer questions based on their journey through the rock cycle.
Expand	5 min	4.2, 5.7, 5.8, 7.2, 7.3	none	2	Students work in small teams to draw a graphic that represents their journey.
Evaluate	5 min	6.2, 7.3	none	1	Students complete worksheets that demonstrate their learning on the rock cycle.

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

Next Generation Science Standards – Inquiry

NGSS Practice 2:Developing and Using Models
NGSS Practice 3: Planning and Carrying Out Investigations
NGSS Practice 4: Analyzing and Interpreting Data
NGSS Practice 6: Constructing explanations
NGSS Practice 7: Engaging in arguments from evidence
NGSS Practice 8: Obtaining, Evaluating and Communicating Information

Next Generation Science Standards – Earth Science

MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

Florida Science Standards - Inquiry

SC.7.N.1.1
(SC.8.N.1.1) Define a problem from the curriculum: use appropriate reference materials to support scientific understanding; plan and carry out scientific investigations of various types, such as systematic observations or experiments; identify variables; collect and organize data; interpret data in charts, tables, and graphics; analyze information; make predictions; and defend conclusions.
SC.7.N.3.2 Identify the benefits and limitations of the use of scientific models

SC. 8.N.3.1 Select models useful in the investigations
Florida Science Standards – Earth Science SC.7.E.6.2 Identify the patterns within the rock cycle and relate them to surface events (weathering and erosion) and subsurface events (plate tectonics and mountain building).

Materials and Advance Preparation

Materials List

Class set:

- one set of rock cycle cubes (pattern attached; see **Blackline Master #1**)
- one set of place markers for each of the 11 stations for the cycle
- Rock Cycle song (to display on Elmo or on Smart Board; **Blackline Master #4**)

Student materials:

- lab sheet (**Blackline Master #2**, 1 copy per student)
- Check for Understanding (**Blackline master #3**, 1 per student)

Blackline Masters

1. **Simulation Cube Instructions**
2. **Rock Cycle Simulation Data Table (two pages)**
3. **Check for Understanding (Evaluation)**
4. **Rock Cycle Song**

Advance Preparation

1. Prepare the cubes as directed on **Blackline Master #1**. Prepare station labels to identify each station.
2. Run copies of **Blackline Master #2** for each student.

Lesson Information

Learning Objectives

1. The student will be able to use the data collected in this lesson (*condition*) to correctly (*standard*) describe their path through the rock cycle (*task*).
2. The student will be able to correctly (*standard*) state, based on their data (*condition*), that their journey through the rock cycle did not necessarily represent the whole rock cycle and that their journey may have taken longer in some places in the rock cycle (*task*).

Prior Knowledge Needed by the Students

- general familiarity with three types of rocks.

Background Information

The rock cycle explains how one rock may transform from one type to another through a variety of geological processes. The rock types are metamorphic, sedimentary and igneous. Metamorphic rock is created through the processes of heating and/or pressure. New minerals that are only found in metamorphic rock can be created in this process. Garnet is an example of a mineral only created through metamorphic processes. Igneous rock is created when molten rock (magma below ground or lava above ground) cools and hardens. If these processes take a long time, then crystals in igneous rock have time to grow large (like you find in granites). If the cooling and hardening takes place rapidly, then crystals can be tiny or even nonexistent (in the case of obsidian). When rocks (this can be igneous, metamorphic or sedimentary rocks) are broken down into smaller pieces (sediment), transported by wind, water or ice, and deposited, they can then undergo compaction and cementation to form sedimentary rock. Given enough time, a mineral might go through all of these various

processes and rock types. However, different parts of the cycle may take longer than others… so the journey is not necessarily a smooth one or one in a constant rate.

Lesson Procedure

Engage

Include guiding questions you might ask to help students. If you use a video (include the URL in your lesson plan instructions) or a book (the author, title and publication date), and include questions that you would ask before, during or after the video/book reading selection.

1. Distribute **Blackline Master #2** (lab sheet) to the students for today's lesson – one per student.
2. Students, today we are going to explore how the Earth recycles rock and mineral material. What do you recall about how the Earth's rocks change from one form to another through the "rock cycle". Does anyone remember the three types of rocks?
3. Show me what you can remember about the rock cycle by drawing it on the back of your lab sheet. Allow about 2-3 minutes. **(PTI 4.2, 5.8, 7.3)**

Explore

This should be a student-centered, hands-on activity that teaches your students about science. No lectures or direct teaching allowed. Please be as hands-on as possible. Also, please provide enough detail so that Dr. Blanchard could teach your lesson based on what you have included in these steps.

1. Place the dice, along with the appropriate station labels around the classroom.
2. Say to students, "From what you know about the rock cycle, where do you PREDICT you will visit the most? Put your answer on the top of your lab sheet. (**Blackline Master #2**)". **(PTI 1.3)**
3. Go over the directions at the top of the lab sheet. Model how to do two or three die tosses and how to record that data on the lab sheet. Discuss what to do if they toss the same station more than once (they write down each toss every time). Emphasize to students that dice should stay on top of the desks and off the floor.
4. Assign students to their starting stations. Make sure students push in their chairs and stow their bookbags so that tripping hazards are reduced. Allow data collection **(PTI 3.1, 3.7, 5.3, 5.8)** to take about 15 minutes (consider putting a countdown timer on your SmartBoard, for example: http://www.classtools.net/education-games-php/timer). Circulate around the room to make sure that students are properly recording their data.
5. When students have begun finishing the collection of their data, have them start answering the remaining questions on the lab sheet. **(PTI 4.3, 5.3)**

Explain

*Include guiding questions you might ask students during the EXPLORE activity. You should have at least **10-15 questions** to guide student discussion and learning.*

1. Some questions you might ask students include,
    1. *Did your prediction turn out to be correct?* **(PTI 4.3)**
    2. *Let's have a few volunteers to tell us about their journey through the rock cycle.*
    3. *Did everyone follow the same route through the rock cycle? Do you think this is like the real rock cycle?* **(PTI 5.2)**
    4. *Was there anything surprising about your journey through the rock cycle?*
    5. *What were some places that you spent the most time?* **(PTI 4.3, 5.3)**
    6. *Why might it take a long time to leave one of the places where you spent a lot of time?* **(PTI 5.3)**
    7. *How does this simulation resemble the rock cycle? What could we do to improve this simulation's attempt to represent the rock cycle?* **(PTI 5.5, 5.8, 5.9)**
    8. *How do you think scientists figured out all the parts to the rock cycle?*
    9. *Did just one scientist figure out the rock cycle by themselves? Explain your answer.*
    10. *Who can give me their definition of "rock cycle"?*
    11. *Why do you think the rock cycle is called a cycle?*

Expand

Include a similar student centered activity that will allow students to practice or connect what they have just learned in Explore. This is not an opportunity to introduce a new topic, but to provide enrichment on the topic of this lesson.

1. Working with at least another one or two students, use your data to draw a graphic **(PTI 4.2, 5.7, 5.8, 7.2, 7.3)** that represents your collective journey through the rock cycle. Keep in mind that your team may not actually complete a journey through all the processes and rock types.
2. Present your collective journey diagram through the rock cycle to your classmates.

Evaluate

FORMAL EVALUTION

a. Attach a FORMAL EVALUATION (1-3 questions) on a separate sheet of paper that you have developed to use as your evaluation tool.
b. For each question, identify in parentheses at the end of the criteria the GLE (GLE#___) and/or Learning Objective (LO#___) you are assessing for your lesson. If you use an Inquiry GLE, please note it as INQ GLE #___.

INFORMAL or OPTIONAL EVALUTIONS

1. Students should be able to construct at least a portion of the rock cycle based on their data from the simulation. The graphic organizer required in the last question of the worksheet is a good assessment for this simulation.
2. Have students write an essay from the view point of a Silica or Oxygen atom as the molecule moves through the rock cycle.
3. Have students rewrite the lyrics of a popular song so that the primary concepts about the rock cycle are included. Students can sing their song for the class.

WRAP UP.

*Bring the lesson to a conclusion by singing "The Rock Cycle Song" (see **Blackline Master #4**).*

Supplementary Resources

Include links to resources that the teachers and students might find useful in learning more about this topic.
Each resource should be in APA citation style and be followed with a one sentence annotation that notes appropriate age or grade level.

Teachers

Earth Revealed (video-on-demand series) (1992). Anneberg Retrieved from
http://www.learner.org/resources/series78.html
Video-on-demand videos on various aspects of the Earth's rock cycle. 26 videos.

Students

McDougall-Littell, Exploring Earth: How Do Rocks Undergo Change? Interactive Rock Cycle Animation
http://www.washington.edu/uwired/outreach/teched/projects/web/rockteam/WebSite/rockcycle.htm.htm
A visual simulation that shows the rock cycle in the context of a convergent plate boundary.

Annenberg Learner Interactives: How Rocks Change
http://www.learner.org/interactives/rockcycle/change.html
Provides a three page complete overview of the rock cycle complete with animations for each page. Includes a six minute challenge over the five processes that are involved in the rock cycle.

CITATION OF SOURCES.

Where did you get the idea/materials for this lesson?(Put the author/date/book name or the Name of the website and the complete URL). I/We used the following resources to build our lesson:

Based on **Regents Earth Science: Rock Cycle Activity,** accessed Summer 2003, no longer available online.

__✓__ Yes, I cited all materials and resources used in this lesson.

Pamela Blanchard
Lesson author signature

Information on how to construct simulation cubes for each station.

FIGURE 1.

A list of stations and how each station's die should be labeled.

Name of station	# of die sides marked with given "Go to" option	Go to:
Station 1. Compaction and cementation	3	Sedimentary rock
	3	Compaction and cementation (stay where you are)
Station 2. High temperature and pressure	3	Metamorphic rock
	3	High temperature and pressure (stay where you are)
Station 3. Sediments	2	Compaction and cementation
	4	Sediments (stay where you are)
Station 4. Igneous rock	2	Weathering and erosion
	2	High temperature and pressure
	2	Melting
Station 5. To the surface	4	Weathering and erosion
	2	To the surface (stay where you are)
Station 6. Metamorphic rock	2	Melting
	2	To the surface
	2	High temperature and pressure
Station 7. Sedimentary rock	2	High temperature and pressure
	2	Melting
	2	Weathering and erosion
Station 8. Melting	3	Magma
	3	Melting (stay where you are)
Station 9. Cooling and hardening (crystallization)	3	Igneous rock
	3	Cooling and hardening (stay where you are)
Station 10. Magma	2	Cooling and hardening
	4	Magma (stay where you are)
Station 11. Weathering and erosion	3	Sediments
	3	Weathering and erosion (stay where you are)

Originally from xxx (xxx)

Blackline Master #2, p. 1

Student Name _____

Rock Cycle Simulation

Thinking Ahead and Making a Prediction.
Do you think that rocks spend equal amounts of time in each part of the rock cycle? Yes. No.
Explain your answer: _____
_____

Directions. Record the station where you are starting your rock cycle journey below. Roll the die at your station and record where it tells you to go next to the Number 1. Go to the station that your die indicated. You will do this each time you roll the die. If you roll the die and it indicates you are to stay at the station, then write the station that you are remaining at for that roll number and wait your turn to roll the die again.

Data. Record the station that you visit during your journey as a rock.

Roll #	Station Name
Start	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Roll #	Station Name
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
Last roll	

Diagramming your journey. Next, draw an arrow from your starting station to the station that you rolled on your first die toss. Label the arrow with the number "1". If you roll the die and it indicates you are to stay at the station, draw a loop back to the station and label it with the appropriate number. Do this for all your die tosses.

Compaction and Cementation

Sedimentary Rock

Igneous Rock

Melting

Sediments

To the Surface

Magma

Metamorphic Rock

Erosion and Weathering

Cooling and Hardening

High Temperature and Pressure

Blackline Master #2, p. 2

Data Analysis. Thinking about your data.

1. Was your prediction that you made at the start of the simulation correct?

2. What does your data tell you about a mineral's journey through the rock cycle?

3. Summarize your journey through the stations, noting where you spent the most time and where you did not go.

4. Based on your data, explain why is the rock cycle called a cycle.

5. Based on your data, create a graphic organizer that illustrates the rock cycle.

Name _____ Date _____ Student No. _____

Checking for Understanding: Rock Cycle Journey

___ 1. What process happens to change igneous or sedimentary rock to metamorphic rock? (LO#1)
A. cooling of magma
B. compaction
C. weathering and erosion
D. heat and pressure

___ 2. A rock spends the same amount of time in each stage of the rock cycle. (LO#2)
A. True
B. False

Explain your answer.

___ 3. Briefly explain in your own words why the rock cycle is really a cycle. (**SC.7.E.6.2**)

Name _____ Date _____ Student No. _____

Checking for Understanding: Rock Cycle Journey

___ 1. What process happens to change igneous or sedimentary rock to metamorphic rock? (LO#1)
A. cooling of magma
B. compaction
C. weathering and erosion
D. heat and pressure

___ 2. A rock spends the same amount of time in each stage of the rock cycle. (LO#2)
A. True
B. False

Explain your answer.

___ 3. Briefly explain in your own words why the rock cycle is really a cycle. (**SC.7.E.6.2**)

Rock Cycle Song

(Sing to the tune of "Row, Row, Row Your Boat")

SEDIMENTARY rock
Has been formed in layers
Often found near water sources
With fossils from decayers.

Then there's IGNEOUS rock
Here since Earth was born
Molten Lava, cooled and hardened
That's how it is formed.

These two types of rocks
Can also be transformed
With pressure, heat and chemicals
METAMORPHIC they'll become.

Source: http://cmase.uark.edu/teacher/workshops/GEMS-lessons/Rock_Cycle_Song.pdf
Karyoke version: http://www.youtube.com/watch?v=F5YSedeq6i0