Rocks (can you be more specific or creative with your title?)

Eilisha Joy Bryson
Science
Meredith School
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1. GUIDING INFORMATION:

a. Student and Classroom Characteristics

There are 25 students in the class, and the class remains together in one classroom with one teacher for all subjects (except for the teachers Preparation Period, during which, students take Phys Ed, Enrichment, Health, and Computer classes). The students will have just began the book that deals with Earth Science; they previously studied Matter. The group generally prefers Science to Social Studies, but do not have many opportunities to have meaningful, worthwhile science class. Much of the focus is spent on Reading, Language Arts, and Mathematics despite the fact that science is scheduled daily. The students do perform well on science written tests, but are not very familiar with science processes and effective scientific practices. They are very talkative during group and independent work time. They definitely work better individually when they are far apart from one another. The classroom is arranged for group collaborations and large class discussions; there are 5 large tables used as student desks that can hold up to 6 students. Students are always expected to think critically and respond to their work on an 8th grade level, but they do not always comply. They are very inconsistent in their interests and work habits.

b. Prior Knowledge

Introduce that a preassessment was conducted, summarize the preassessment as well as the research in two full paragraphs, and then connect these to your lesson goal. Please cite sources as you refer to them.

Students' prior knowledge about the rock cycle and how rocks change was almost non-existent. Many had not heard of the rock cycle before, and based on their response, they do not understand its steps. Students were unable to correctly label the process within the cycle. They were aware that magma was connected with heating. One student knew that it takes rocks millions of years to complete the cycle- everyone else thought it took a few months or a few years. This was a known misconception that people have.

2. PURPOSES:

a. Major Concepts

The rock cycle is a key idea in understanding the history of the Earth in terms of how it took its form, and how it continues to change.

Integrated Science (year) defined rocks in a logical way. "Elements are *chemically* combined to make minerals. Minerals are *physically* combined to make rocks. A rock is defined as an aggregation of one or more minerals and perhaps other materials that have been brought together into a cohesive solid" (p. 280). There are three different types of rocks- igneous, sedimentary, and metamorphic- based on the different ways in which rocks are formed. Rocks are constantly

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changing, and they go through a cycle. The different processes that change a rock's form are: erosion, deposition, heat, pressure, lithification (compaction and cementation), and cooling and crystallization. How these processes actually change a rock is described further below.

The purpose of studying the rock cycle has to do with learning about the earth's formation. The rocks reveal information about minerals and resources that are found in certain areas of the earth. By interpreting the structure of rocks, it can reveal information about the events in earth's history. Knowing about the rock and rock structures also provides insight into how the earth came to look the way it does now, and how and why it changes.

All rocks, according to Integrated Science (year), were said to once have been igneous. The name igneous actually comes from the Latin word *ignis*, or fire, because igneous rocks begin as magma, "melted rock material" and become rock after the magma has cooled and solidified (p. 280). The following information is necessary because it explains how igneous rocks are formed, but it also explains how rocks are able to change from one type into another type. The magma that forms the igneous rock is actually made from rocks- any type of rock- metamorphic, sedimentary, or even igneous. It is important to understand this process because it illustrates how rocks can change, which is the whole basis of the rock cycle.

Inside the Restless Earth (year) states that the magma that creates igneous rocks can form in three ways, all of which involve melting rock. Magma will form when rocks are heated to temperatures that cause some or all of the minerals within the rock to reach their melting points. The melting point of rocks can change when its chemical composition changes. This happens if other elements combine with the rock, and magma then forms. The final way magma forms is when rocks melt because they have less pressure on them. Higher levels of pressure, from being deep within the Earth, cause the minerals within rocks to remain as solids. When the rocks rise to fewer depths, the pressure is released and the minerals can melt, thereby forming magma.

Another rock that can form as rocks get recycled through the rock cycle is sedimentary rock. This type of rock is formed from dissolved, eroded pieces of metamorphic, igneous, other sedimentary rocks, or from dead sea creatures. Water ice, heat, and wind erode the elements and the pieces, or sediments, are carried away. The sediment forms on the Earth's surface in layers, many of which are on the bottoms of seas. These fragments alone do not create rocks. In order for the sediment to join together two things must happen. The explanation of this is explained well in the Inside the Restless Earth textbook.

> As new layers of sediment are deposited, they cover older layers. Older layers become compacted. Dissolved minerals, such as calcite and quartz, separate from water that passes through the sediment to form a natural cement that binds the rocks and mineral fragments together into sedimentary rock. (p. 40)

Once the bonding has occurred, the International Encyclopedia of Science and Technology, says that the Earth can move causing the sediments to "uplift … and tilt, fold, or fault" thereby creating the sedimentary rock (p.318). One distinguishing feature of sedimentary rock is its visible layers, or strata.

The last type of rock is metamorphic rock. It takes its name, as Inside the Restless Earth notes, from two Latin words, *meta* (meaning change) and *morphos* (meaning shape). A metamorphic rock is one that has changed its shape or chemical composition in a "distinctly different" way (Integrated Science, p. 282). Heat and pressure are the two factors that can cause such a change: heat and pressure. The heat comes from the magma, either through direct or indirect contact. Pressure can come from movements of the Earth. The heat and pressure interact with a pre-existing rock and alter its shape or mineral alignment. These behaviors are similar to those that

cause rocks to melt into magma and cool into igneous rock, but they are slightly different. The pressure and heat are not enough to melt the rock, just change its solid form. This is the final way rock can change in the rock cycle.

The International Encyclopedia of Science and Technology and Inside the Restless Earth note that there are two important characteristics that all rocks have. One is the texture of the rock. For igneous rocks, that is determined by the location and rate in which the magma cools. A rock's texture is "coarse, medium, or fine-grained" (Inside the Restless Earth). Fine-grained igneous rocks, for example, will have small or no crystals. This happens when magma cools quickly on the Earth's surface, not allowing enough time for crystals to form. Igneous rocks that are formed under the Earth's surface, where temperatures are hotter, will cool at a slower rate. The large crystals will have time to take shape, causing the igneous rock to be coarser. The other characteristic is the chemical makeup of the rock, or its composition.

b. Learning Goals

The students will ultimately be able to conduct a lab modeling the rock cycle. They will need to make connections between what they will be doing in the lab to what actually happens to rocks on Earth.

c. Objectives

1. Students will be able to describe four processes that shape Earth's features: (list).
2. Students will be able to describe how each type of rock changes into another type as it moves through the rock cycle.

d. State Standards

PA State Standards:

Unifying Themes:

3.1.10 E Describe patterns of change in nature, physical, and man-made systems.

Earth Science:

3.5.10 A Relate Earth features and processes that change the Earth.

The National Science Education Standards:

Earth and Space Science-

Science Content D - students should have knowledge of the "structure of the earth system"

- Students can investigate the water and rock cycles as introductory examples of geophysical and geochemical cycles.
- Some changes within the solid earth can be described as the "rock cycle." Old rocks at the earth's surface weather, forming sediments that are buried, then compacted, heated, and often recrystallized into new rock. Eventually, those new rocks may be brought to the surface by the forces that drive plate motions, and the rock cycle continues.

The Benchmarks (grades 6 to 8):

- Sedimentary rock buried deep enough may be reformed by pressure and heat, perhaps melting and re-crystallizing into different kinds of rock. These re-formed

rock layers may be forced up again to become land surface and even mountains. Subsequently, this new rock too will erode. Rock bears evidence of the minerals, temperatures, and forces that created it.

3. RATIONALE:

My plans for these lessons are for students to gain a deeper understanding of the rock cycle than a diagram in the book could offer. The lessons below are simple, but they provide explanation and exposure to the content needed. My students are very unaware of the rock cycle, and need basic information. They have to learn about the processes because without them the rock cycle would not make sense. They will also revisit those concepts later in the text. These are the beginning lessons on the unit about rocks, so more lessons will be planned to explain the igneous, metamorphic, and sedimentary rocks later.

4. CLASSROOM PREPARATION:

a. Instructional Materials
Chart paper
Transparency: The Rock Cycle
Overhead Projector
Unlined paper
Textbooks
Student notebooks
List of websites about the rock cycle (see attachments)
Materials for the lab (see attachment)

b. Management and grouping patterns
For day one, students are working as a large group since they will be doing a shared reading with the teacher. As they work on their flowcharts, students will work independently, but table interaction is encouraged so that students can help one another if needed.
On day two, students will be working as a large group while they observe the animation. Students can then work in pairs to further explore other Internet resources about the rock cycle.
On day three, students will work in groups of 4 to complete the lab.

c. Safety
Safety is not an issue on days one or two, but is of concern on day three when students complete their lab. The lab requires use of a hot plate. Students are to wear protective goggles, heat-resistant gloves, and must demonstrate care while working with hot water.

5. TEACHING METHOD(S), INSTRUCTIONAL PROCEDURES, AND LEARNING ACTIVITIES:

<u>Day 1</u>

a. Phase of Inquiry:

Engage: Students will participate in a brief activity to help them access their prior knowledge as to have information so that they can make connections throughout the lessons.

Explain: Students will learn about the rock cycle and will organize the information into a flowchart (graphic organizer). This will be used throughout the lessons to assist in completing independent activities and as a studying tool.

b. Content

On this first day, students will be working on both of the objectives: describing the four processes that shape Earth's features, and describing how each type of rock changes into another type as it moves through the rock cycle. The students will discuss the terms of the process and hear the explanation behind the rock cycle.

c. Motivational opening

Students will do a think-pair-share based on the following prompt: *List and give a brief description of anything you know that goes through a cycle.* Students should *think* and record their own thoughts, and, after directed, *pair* up with their tablemates *to* discuss their ideas. The teacher will then ask the tables to share their findings with the entire class. She will record their ideas on chart paper. After that, the teacher will ask all of the students to jot down their thoughts when they hear the term "recycle". Ask a few students to share their thoughts with the class. The teacher will emphasize that they will be studying one of nature's cycles- The Rock Cycle- and give the standards and objectives for the lesson. The teacher will then distribute rock samples to each group and allow students to observe and "play" with them.

d. Core Learning Activities

The teacher will read "The Rock Cycle" section of the textbook with the students. The teacher will elaborate and provide additional information as she reads. Student should take note of the definitions and concepts, such as: erosion, weathering, deposition, heat and pressure. The teacher will display an overhead transparency of the rock cycle (the same one from their pre-assessment) and discuss with the class. The teacher will model how to make a flow chart, and then the students will make one of the rock cycle.

Please explain why you chose "reading about science" as a strategy that best helps students to develop conceptual understanding at this stage. I did not see anything in your description of the class to suggest that students cannot read on their own.

What do the students learn copying their rock cycle flow chart from their textbook onto a sheet of paper?

How can you give the students a more active role in exploring ideas and constructing understanding?

e. Critical Questions

What processes can change rocks? Briefly describe them.
How does one type of rock change into another type?

f. Closure
At the end of day one, the teacher will review the flow chart that the students created from the section. This suggests that only one type of flow chart is possible. Students will be advised to rewrite their flowchart for homework. Distribute blank paper for students to use.

Day 2

a. Phase of Inquiry
Explain: Students will learn about the rock cycle in another approach.
Explore: Students will have the opportunity to explore websites on the Internet to gain more information about the rock cycle.

b. Content
Students' work today will be focused around the two learning objectives about the four processes and the ways that rocks change from one form into another.

c. Motivational opening
Tell students that we will again learn about the rock cycle, but that we will not be relying on our textbooks. We will see an animation of the rock cycle from a website.

d. Core Learning Activities
The teacher will utilize the Smart Board and projector to show students an animation of the rock cycle. Students should have their flowcharts in front of them while viewing the animation so they can make connections. The teacher will go online to the Houghton Mifflin interactive rock cycle at the following web address:
http://www.classzone.com/books/earth_science/terc/content/investigations/es0602/es0602page02.cfm (side note: In case you were wondering about the quality of work at this web site, I can vouch for it. This is an excellent source for earth science animations. Highly qualified people did it using funding from the National Science Foundation – a friend of mine in Boston managed this project.)

The first process illustrated in this animation is crystallization. It was missing from your list of important processes. That's another reason that I think it should be in. Igneous rocks are crystalline, as are many metamorphic rocks.
Once there the teacher will run through the interactive rock cycle, stopping to further explain or answer questions as needed. This visual animation of the rock cycle should help visual learners and all students who may have struggled grasping the concept of the processes and changes that rocks go through. Students should take additional notes while viewing.

e. Critical Questions
What are the four processes that cause changes in Earth's rocks?
How does one rock change into another type of rock?

f. Closure
The teacher will allow students to continue to view the animation as needed, either in the computer lab, library, or on classroom computers. Students should have enough information in their notebooks to thoroughly explain the rock cycle. The teacher will provide a list of websites that students can also visit pertaining to the rock cycle. Students will be required to summarize what they did during the exploration time in their notebooks.

Day 3

a. Phase of Inquiry
Explore: In today's lesson, students will do a lab on the rock cycle.
Evaluate: The lab will be used as an assessment of their knowledge of the rock cycle.

b. Content
This lab will be addressing the two objectives for this entire lesson: describing the processes, and describing how each type of rock changes.

c. Motivational opening
Tell students that today they will model the processes rocks go through in the rock cycle. Explain that they will model this in a lab activity.

d. Core Learning Activities
Begin with a review of the flowchart from homework the night before. Engage students in a discussion about how they think they could model the rock cycle in a lab. Try to evaluate the responses to judge students' perceptions of the time it takes to change rock forms, and the ease of doing so. Review the lab activity with the class. (Refer to lab sheet for lab procedures.) Walk around the room to monitor students for safety and for help. Allow students time to discuss the analysis of the lab. Walk around the room to visit each group during their discussion to keep them on task and to clarify any questions.

e. Critical Questions
If sugar represents rock, what does sugar represent at each stage of the lab?

f. Closure
Ask each student to write a brief reflection of the lab activity, they may comment, ask a questions, etc. For homework, students should rewrite the lab activity following the steps of the scientific method.

6. EVALUATION STRATEGIES
The students will receive an informal evaluation of their flow chart and Internet site summary from day one and two, respectively. On day three, a formal evaluation will be made from the

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lab activity. The rubric consists of three areas: material and equipment use, quality and clarity of observation, and analysis. The rubric is attached in section 8.

Joy:

I can't think of a good reason to have the lab follow all the reading and charting. It should be first.

Engage the students in exploration through hands-on activity first.
Then let them develop the explanations and read the book and learn or memorize the terms.
I can't imagine that the research on learning about the rock cycle told you that all these charts and reading is how students best learn that processes that take thousands to millions of years can change one thing slowly into another.

Seeing sediments in a rock helps you to place it in the sedimentary rock box. Seeing crystals in an igneous rock helps you to put in a box where rocks that have been melted then cooled and crystallize belong. Seeing a deformed metamorphic rock helps you to understand that pressure deforms things and so deformed rocks belong in the metamorphic box. Squeezing two small stcked pieces of modeling clay so that the clay gets deformed and stretched also helps you to do this – you feel the pressure and you see the change with your eyes. Readings and cartoons can follow.

7. REFLECTION:

[leave blank - to be completed after instruction. This is your reflective presentation in the final week of classes]

8. ATTACHMENTS:

Rock Cycle References
Transparency of the Rock Cycle
Performance-Based Assessment (Teacher's Notes, Rubric, and Answer Key)
Performance Based Assessment (Blackline master)