

The Keepers of Michigan's Natural Resources- Rocks!

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Introduction:

Often when most citizens look at rocks they see exactly that, a rock. They do not see a marker of time, a survivor of extreme processes, or a piece of art that has existed longer than most anything currently on earth. Each rock may have some minerals in common yet they were processed differently and therefore they have a different outcome. Citizens should know how to tell rocks apart and what rocks are used for so they can be knowledgeable in their future decisions. Whether it stores water or natural gas, rocks are so much more than plain old rocks.

Grade Level: 6th-8th Grade

Objectives:

Students will apply what they know about the rock cycle to explain how the grains and the pores in the rocks are different.

Students will illustrate their knowledge of how ground water is acquired.

Students will test some Michigan rocks: slate, sandstone, granite, and basalt to determine which rocks would make good permeable layers for aquifers and which would make good impermeable layers to protect aquifers.

Students will apply what they learned about rocks used in aquifers to question how rocks are used in the collection of natural gas in fracking.

Benchmarks:

E.SE.06.41 Compare and contrast the formation of rock types (igneous, metamorphic, and sedimentary) and demonstrate the similarities and differences using the rock cycle model.

E.ES.07.82 Analyze the flow of water between the components of a watershed, including surface features (lakes, streams, rivers, wetlands) and groundwater.

E3.1A Discriminate between igneous, metamorphic and sedimentary rocks and describe the processes that change one rock into another.

E3.1B Explain the relationship between the rock cycle and plate tectonics theory in regard to the origin of sedimentary, metamorphic and igneous rocks.

Safety:

Students will be using water, eyedroppers and several samples of rocks. Students should not squirt others with the water in their eyedroppers. Students will be using goggles.

Big Ideas:

Big Idea 7: Humans depend on Earth for resources. Specifically these:

7.3 Natural Resources are limited 7.4 Natural Resources are distributed unevenly around the planet.

7.5 Water resources are essential for agriculture, manufacturing, energy production and life. 7.8 Oil and natural gas are unique resources that are central to modern life in many different ways.

Engage: What does a ground water collection site in Michigan look like?

Hand out Figure 1- Groundwater in Michigan to each student. Have the students put their names on the back of the paper. The students will draw a cross-section of the ground below them and what they think it looks like where there is a water well drawn. This is a starting point to talk to the students about where they think their water comes from and a pre-knowledge assessment for what they already know.

Collect the students work and show a few examples. Have a class discussion about similarities and differences without giving any favorable comments towards anything.

Ask the following questions of the class after looking at the pictures:

1. How did the water get to the well?(it permeated into the ground from the top and infiltrated through the layers of soil and loose rock until it hit an impermeable layer of rock) Write the Vocabulary on the board- permeate, infiltrate, impermeable and permeable.
2. What do we know about weathering and the formation of soil? (soil is formed from weathered rock, organic matter and various sizes of rock.

Explore- Testing the rocks for permeability.

1. Pass out the Pore Pore Rocks paper to each student and go through the directions with them. Students will work in groups of three or four. After the students get the paper they will assign roles to the group.

Materials person- who will get the materials and return them- if anything is missing this person will be responsible for finding it.

Timer- this person will be in charge of timing how long the water takes to be absorbed or call the time after 3 minutes.

Recorder- This person makes sure everyone has the information down in the group.

Reporter- This person is in charge of putting the data on the whiteboard.

2. The students will arrange the rocks from the bowl in the order that is on the paper, using the Figure 2 chart for identification. This will be the order in which they are tested.
3. The students will each make a hypothesis as to which rocks are permeable and which rocks are not. (Write the definitions on the board)

4. The timer will prepare to time with either a stopwatch or using another time source in the room designated by the teacher.
5. Then starting with the person with the shortest hair, the student will take an eyedropper $\frac{1}{2}$ full with water and when the timer says go, the short haired student drops 5 drops on the first rock to be tested. They will watch to see if the water is absorbed into the rock, if it sits on top or rolls off. All students will write down their results with the Recorder making sure that everyone has the same data.
6. If the water is absorbed then the time it was absorbed in will be recorded and the next rock is tested. If the water is not absorbed after three minutes, record the results and test the next rock.
7. Then the person to the left of the person with the shortest hair will test the next rock while others record the data. Proceed with each person to the left until all the rocks have been tested.
8. After all the rocks have been tested, determine what kind of rock (sedimentary, metamorphic or igneous) they are using the Figure 3 rock chart. While the group is working the recorder puts the groups data on the board as to which rocks had water infiltrate and how long it took and which did not.
9. Students will then answer the questions at the bottom of the paper.

Elaborate- What types of rock are permeable and good in aquifers and which are impermeable and good for protecting the aquifer.

Using their data the students will answer the question on the bottom of their papers as to which type of rocks would be useful in an aquifer- the more permeable (sandstone), and which would be good for holding the water- the impermeable (slate, granite). A class discussion about how a pore is the area between to rocks or sediments in a rock and how the larger the pore is more water it can hold. Therefore sandstone holds more water than the other metamorphic and igneous rocks due to the crystallization that occurs due to the heat they withstand.

Then using their information they have gathered- hand back their groundwater pictures and have them correct or add details to them like types of rocks or other things they have learned.

The Students would then hand in both the Groundwater paper and their Pore, Pore, Rocks.

Extension-

Homework- Students would compare what they know about ground water and what kinds of rocks are needed to the types of rocks used in the fracking process and answer questions about the article.

Resources:

The Groundwater in Michigan Engagement activity from Dr. Steve Mattox was done on 7/19/12 with MiTEP Cohort 3.

The pictures of the rocks in the Rock Chart are from the following sources:

Basalt	flashcardmachine.com
Granite	pitt.edu
Conglomerate	exploringthepotteries.org.uk
Sandstone	earthscienceeducation.com
Shale	media.hcpss.org
Limestone	flexiblelearning.auckland.ac.nz
Quartzite	pitt.edu
Slate	newspaper.li
Schist	itc.gsw.edu
Gneiss	skywalker.cochise.edu

Homework article adaptation

http://www.michigan.gov/documents/deq/deq-FINAL-frack-QA_384089_7.pdf

Pore, Pore Rocks

Name _____

Assign roles to your group

Materials person- who will get the materials and return them- if anything is missing this person will be responsible for finding it.

Name _____

Timer- this person will be in charge of timing how long the water takes to be absorbed or call the time after 3 minutes.

Name _____

Recorder- This person makes sure everyone has the information down in the group.

Name _____

Reporter- This person is in charge of putting the data on the whiteboard.

Name _____

Vocabulary:

Permeable- _____

Impermeable- _____

Evidence

Number	Name of the rock	Did the water permeate?	How much time did it take?	What type of rock is this? (igneous, metamorphic, sedimentary)
#1	Granite			
#2	Slate			
#3	Sandstone			
#4	Basalt			

TEACHER INITIALS THAT YOU HAVE THE CORRECT ORDER _____

Claim: Write down which **rock(s)** are permeable and impermeable.

I think that the _____ will be permeable.

I think that the _____ will be impermeable.

Why did you choose the way you did?

Safety: All students will need to wear goggles

Materials: bowl of rock samples, eyedropper, container of water (50 ml), safety goggles for all, time source(stopwatch, wall clock, etc...), Figure 2 rock chart, Figure 2a- rock test paper, paper towel

Procedure:

1. The materials person goes to get the bowl of rocks, the Figure 2a sheet and the Rock chart, bringing them back to the group station.
2. Everyone reads the directions before doing the lab.
3. Arrange the rocks on the Figure 2a paper- Rock Test Paper, using the Figure 3 Rock chart.
4. When you have the rocks arranged, raise your hand to have your paper checked. Your teacher must initial your papers to go on.
5. Everyone makes their hypothesis and supports it.
6. Everyone puts on goggles.
7. The materials person goes to get the rest of the supplies.
8. The timer will prepare to time with either a stopwatch or using another time source in the room designated by the teacher.
9. The testing will start with the person with the shortest hair, the student will take an eyedropper $\frac{1}{2}$ full with water.
10. When the timer says go, the short haired student drops 5 drops of water on the first rock to be tested.
11. They will watch to see if the water is absorbed into the rock, if it sits on top or rolls off.
12. All students will write down their results with the Recorder making sure that everyone has the same data.
13. If the water is absorbed then the time it was absorbed in will be recorded and the next rock is tested. If the water is not absorbed after three minutes, record the results and test the next rock.
14. Then the person to the left of the person with the shortest hair will test the next rock while others record the data. Proceed with each person to the left until all the rocks have been tested.
15. After all the rocks have been tested, determine what type of rock (sedimentary, metamorphic or igneous) they are using the Figure 3 rock chart. The materials person puts the supplies away and cleans up the area with paper towel.
16. While the group is working the recorder puts the groups data on the board as to which rocks had water infiltrate and how long it took and which did not.
17. All students will then answer the questions at the bottom of the paper.

Reasoning:

1. Was your hypothesis correct?_____ If it wasn't correct, make the corrections here.

2. Looking at the rocks, why do you think that they were permeable or impermeable rocks?

3. Why is this lab called "Pore, Pore, Rock"? Where is the pore in a rock?

Homework- Rocks as Natural Resources

Name _____

Read the article about fracking and answer the questions at the bottom.

What the Frack is Fracking?

Fracking is the slang term for hydraulic fracturing, which is the process that maximizes the output of natural gas and oil wells to make them productive. Fracking is not a new technology as it has been used since the 1940's to collect natural gas from oil rich shale rocks.

The process of fracking is when a combination of water, sand and a chemical are pumped down a well into an area that is has oil rich shale. By using this combination of water, sand and chemical under pressure, the shale is cracked and the sand fills in the gaps created while the "flow back" water and the chemical release the natural gas and or oil back up the well and the gas/oil is collected in one container and the "flow back" water and chemical are collected in another.

There have been some concerns over the "flow back" water and chemical polluting water sources, but in Michigan the Department of Environmental Quality strictly monitor the 12,000 wells currently working and there have not been any serious incidents.

Article adapted from: http://www.michigan.gov/documents/deq/deq-FINAL-frack-QA_384089_7.pdf

7/28/12



Questions:





1. How are fracking and groundwater collection similar?
2. What types of rock are permeable to water?
3. What types of rock contain natural gas/oil?
4. Both types of rock mentioned above are sedimentary rocks. What kind of situation might cause concern to people who live by a fracking well?
5. In the area below, write one question you have about fracking.

Place Rocks here to be tested----Figure 2a- Rock Test paper

#1-Granite	
#2- Slate	
#3- Sandstone	
#4- Basalt	

Figure 2- Chart of rocks

Rock Type	Observable Characteristics	Where Formed	Example
1. Igneous			
Volcanic (Extrusive)	Crystals so small you can't see them with the unaided eye. Sometimes there are larger, visible crystals in a very fine-grained matrix.	These rocks were once liquid magma that erupted from volcanoes. They cooled very quickly, which is why the crystals are usually very small.	<p>Basalt – usually dark gray to black, fine-grained volcanic rock; sometimes has gas bubbles (vesicles)</p> 
Intrusive	Interlocking Crystals	These rocks were once liquid magma, but they did not erupt from volcanoes. Instead, they cooled slowly underground. The crystals had time to grow large. We see them because erosion has stripped off and removed all of the rock above it.	<p>Granite – pinkish, whitish igneous rock with interlocking crystals of quartz and feldspar. Sometimes includes mica.</p> 

<p>2. Sedimentary</p>			
<p>Clastic</p>	<p>Made up of smaller rocks cemented together. Sometimes has fossils. Usually has layers.</p>	<p>These rocks formed when loose sediment (rocks, sand) were deposited by water, compacted, and cemented together. These rocks form along beaches, by rivers, or under the water in lake or oceans.</p>	<p>Conglomerate – composed of pieces pebble-size or larger</p>  <p>Sandstone - composed of sand-size pieces</p>  <p>Shale - composed of pieces smaller than fine sand</p> 
<p>Chemical</p>	<p>Usually a light gray, sometimes with crystals, sometimes with shells, sometimes just massive.</p>	<p>These rocks are also deposited in water. However, they form as a chemical reaction in the water that leaves a chemical deposit, usually on an ocean bottom.</p>	<p>Limestone – a whitish or grayish rock made of the mineral calcite.</p> 

3.
Metamorphic

Usually has interlocking crystals and layers (called foliation)

These rocks formed when igneous, sedimentary, or other metamorphic rocks are heated and/or squished, forming a new rock type. This usually happens during mountain building events (regional metamorphism), but also happens during igneous activity (contact metamorphism).

Quartzite – metamorphosed sandstone



Slate – metamorphosed shale.



Schist – metamorphosed sedimentary rocks that had lots of clay.



Gneiss – metamorphosed granite.



